



# **A New Theorisation of Internal Integration (II): The Interplay between a Process Approach and Product Architecture**

By  
Vajihe Javadian

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Royal Holloway, University of London  
School of Management

Supervisors: Dr Adrian E Coronado Mondragon  
&  
Dr José-Rodrigo Córdoba-Pachón

I Vajihe Javadian hereby declare that this thesis and the work presented in it is entirely my own. Where I have consulted the work of others, this is always clearly stated.

Signed:

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## Table of Abbreviations

Abbreviation	Full Form
AMOS	Analysis of a Moment Structures
ASC	Agent-System-Co-Development
AVE	Average Variance Extracted
BIS	Business, Innovation and Skills
BPM	Business Process Management
BPO	Business Process Orientation
BPR	Business Process Reengineering
BPR	Business Process Reengineering
CC	Cooperative Communication
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CFPVB	Customer-Focused Process Values & Beliefs
CLF	Common Latent Factor
CMV	Common Method Variance
CT	Contingency Theory
CTPO	Cooperative Task Planning Orientation
df	Degree of Freedom
DVs	Dependent Variables
EFA	Exploratory Factor Analysis
ERP	Enterprise Resource Planning
ERP	Enterprise Resource Planning
FAME	Financial Analysis Made Easy



GFI	Goodness-of-Fit
GSCF	The Global Supply Chain Forum
IDBR	Inter Departmental Business Register
II	Internal Integration
IVs	Independent Variables
KMO	Kaiser-Meyer-Olkin
KPIs	Key Performance Indicators
KTPs	Key Turning Points
MAR	Missing at Random
MCAR	Missing Completely at Random
ML	Maximum Likelihood
MMA	Multiple Mediation Analysis
MMR	Moderated Multiple Regression
MNAR	Missing not at Random
MSA	Measure of Sampling Adequacy
MVA	Missing Value Analysis
NPD	New Product Development
OECD	The Organisation of Economic Co-operations and Development
OM	Operations Management
ONS	Office for National Statistics
PAYE	Pay as You Earn
PCA	Principle Components Analysis
PJ	Process Job
PM	Product Modularity
PMM	Process Management & Measurement
PS	Process Structure
PV	Process View
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
RQs	Research Questions
SC	Supply Chain
SCC	Supply Chain Collaboration
SCI	Supply Chain Integration
SCM	Supply Chain Management
SCOR	Supply-Chain Operations Reference
SCT	Strategic Choice Theory
SEE	Standard Error of Estimate
SEM	Structural Equation Modelling
SIC 2007	The UK Standard Industrial Classification
SMEs	Small and Medium-Sized Enterprises
SPSS	Statistical Package for the Social Sciences
SRMR	Standardised Root Mean Square Root
SS	Sum of Square
TQM	Total Quality Management
VAT	Value-Added Tax
VIF	Variance Inflation Factor

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## Abstract

With the changing nature of competition shifting from business to business to focus on the supply chains (SCs) effectiveness, firms are increasingly facing new challenges that entail a great deal of integration to increase their supply chains (SC) transparency. Lack of a mechanism to employ current integrative practices and adopt integrated relationships within organisations compromises attempts to meet supply chain integration (SCI) objectives. While previous research proclaims the strategic importance of integration at intra-firm level, the need for well-established techniques in managing collaborative activities and achieve internal integration (II) still presents a relatively underdeveloped frontier in the field of supply chain management (SCM). Research has broadly drawn on the relevance of process approach and product architecture for the supply chain (SC) design issues. The role of process approach is particularly highlighted as a mechanism to manage the supply chain (SC) activities. It is believed that through emphasising on a firm core business processes, process view provides an integrated approach which includes organisational strategies, structural and cultural aspects and entails a fundamental transformation in jobs structure, the formation of common language for communication as well as customer-oriented measurement system. Similarly, modularity as a product architecture property is argued to play a key role in defining the collaborative nature of the value-chain activities. Yet, previous works have failed to investigate internal integration (II) from the standpoints of process approach and product architecture.

The key purpose of this research lies in developing a multi-dimensional model of internal integration (II) and examining the interplay between process approach and product architecture. By taking a process approach, it seeks to investigate the application of business process orientation (BPO) in developing social capitals which form the underlying basis of cooperative relationships. More specifically, it surveys and assesses the contribution of each BPO dimension in enabling integration, while discoursing the way in which its relational and attitudinal features are influenced. Given the dependencies among decisions across process, supply chain (SC) and product domains, it further aims to examine the role of product modularity (PM) in influencing the relationship between business process orientation (BPO) and internal integration (II). As such, it seeks to explain the interaction effect of business process orientation (BPO) and product modularity (PM) on the level of integration across organisational functions. In order to achieve the true representation of the BPO\_II relationship, the research develops three competing models that are theoretically grounded on the logics of contingency theory (CT) and competing models approach and are informed by the extant literature. In addition, product modularity (PM) is included in the theoretical framework to examine how it moderates this relationship. Using a survey questionnaire method, data are collected from a sample of OEMs and suppliers in five high- and medium-

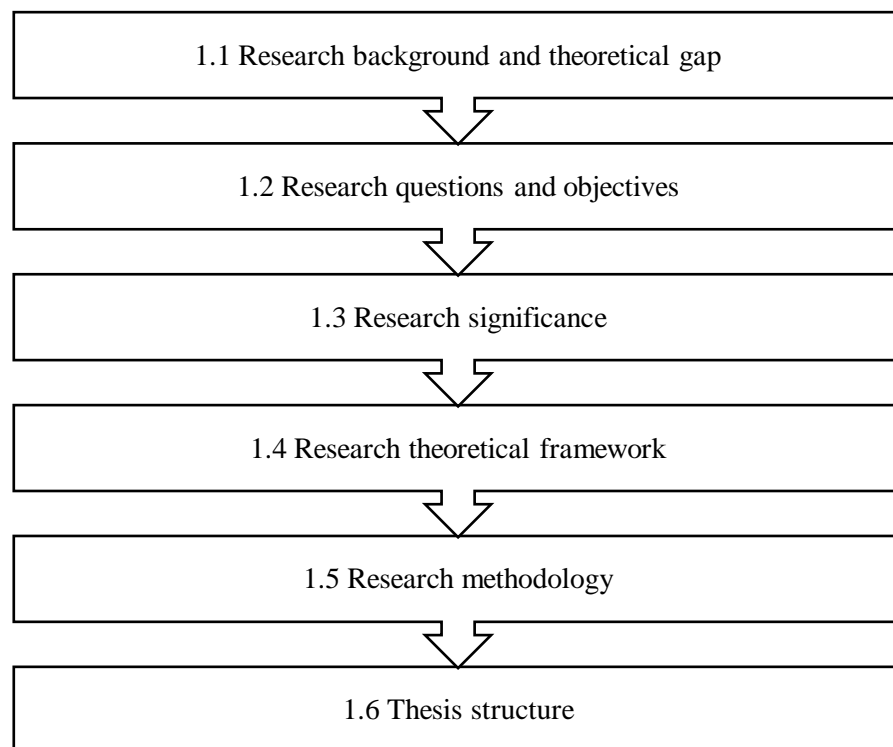
tech manufacturing sectors in the UK. Prior to survey administration, a pilot study is conducted to refine the questionnaire and improve the validity of data collection instrument. Quantitative methods are used to conduct a series of statistical techniques, including multiple regression analyses (MRA), bootstrap multiple mediation analysis (MMA), and structural equation modelling (SEM) in testing the research hypotheses and theoretical model.

Empirical evidence presented mounts on the importance of process approach in nurturing integration. In keeping with our predictions, it is suggested that there is a strong relationship between business process orientation (BPO) and internal integration (II), and the combined effect of BPO dimensions developed in parallel provides the highest magnitude of impact on integration. Our model provides the first step towards suggesting the factors that serve the underlying basis of intra-firm integration. These findings inform our investigation into the moderation effect of product modularity (PM). The analyses revealed mixed and interesting findings suggesting that with its multifaceted implications PM is both an enabler and inhibitor to a process-based organisation. In general, our findings supported that product architecture characteristics have a bearing on operational decisions concerning multiple functions. The interaction effects of PM and BPO demonstrate three forms of relationships, including complementary, interactive and additive. Counter to our prediction, it is found that modular product architecture not only is not in conflict with the objectives of process approach, but it also facilitates the adoption of certain process-based practices, which, in turn, enables more effective cooperative communication across operational boundaries. However, its adoption might become an invisible barrier to a process-oriented task structure and as such hamper this cooperation. With these results, both process- and product-oriented techniques seem to contribute into the outlook of coordinated approach within an organisation. By integrating the insights from distinct literature (i.e. supply chain management (SCM) and business process management (BPM)), the proposed theoretical model advances the existing knowledge and perception on the means to achieve internal integration (II). Therefore, while it provides some valuable practical insights for managers, the main contribution of this paper is in theorising II from process and product architecture perspectives and empirically testing their posited relationship in a multi-dimensional model.

# Chapter One: Introduction

## 1. Introduction

This chapter seeks to present an overview of the research theoretical context in an attempt to set the scene on the scope of the research. In order to develop a better understanding of the research aims and objectives, the chapter starts by providing a background on the importance of internal integration (II) in the supply chain management (SCM) field. The research gap is then identified drawing upon the fundamental aspects of integration. Following this, the key research questions are presented, the research significance is briefly discussed, and the theoretical framework is proposed. The philosophical and methodological approaches of the research are then outlined briefly. The chapter ends by presenting the thesis structure. Figure 1.1 illustrates a summary of the chapter structure.



*Figure 1.1. Summary of Chapter One Structure*

### 1.1. Research Background and Theoretical Gap

With the emergence of a new form of competition focused on supply chains (SCs) effectiveness as opposed to the conventional competition, which was between firms as isolated and independent entities, organisations are faced with new challenges that entail a great deal of integration to increase supply chain (SC) transparency. Firms largely draw on their value-

adding activities to improve supply chain (SC) performance through integrating key business functions (Fawcett and Magnan, 2002). Their corporate success depends on leveraging effective practices to promote collaborative mechanisms and integrate behaviours and attitudes into coordinated and manageable process to meet customer needs (Kahn and Mentzer, 1996, Khosravi, 2016, Talib et al., 2019). According to a Vallet-Bellmunt and Rivera-Torres (2013), the term ‘integration’ is defined as interaction and collaboration across multiple functional entities which involve joint works and activities in order to achieve unity of purpose. At the heart of these relationships is key business processes which set the stage for “those that directly produce an organisation’s outputs” (Barki and Pinsonneault, 2005, p.167). With its far-reaching scope, it encompasses attitudes, patterns and practices which cover different organisational levels of a company (i.e. corporate, strategic, and operative, respectively). While, the supply chain management (SCM) literature has matured enough to identify the multi-dimensionality of integration (e.g. Pagell, 2004, Fabbe-Costes and Jahre, 2007, Basnet and Wisner, 2012, Vallet-Bellmunt and Rivera-Torres, 2013), what constitutes its underlying basis is still an open debate (Pagell, 2004, Basnet and Wisner, 2012, Talib et al., 2019). Prior research has confirmed the strategic importance of integration not only because the supply chain management (SCM) effectiveness is grounded on it, but also due to its value creation benefits (Sweeney, 2013). Predominantly, it has been perceived as an internal competency which could be associated with higher levels of customer service and other forms of performance metrics (Basnet and Wisner, 2012, Monckza et al., 2015). Additionally, it has been recognised as the prerequisite of an extended supply chain integration (SCI) by which firms can absorb, establish and maintain external integration capabilities (Bessant et al, 2003, Rosenzweig et al., 2003, Sanders, 2007, Narasimhan et al., 2010, Flynn et al., 2010, Huo, 2012, Zhao et al., 2011, Horn et al., 2014).

While prior research has emphasised the strategic value of internal integration (II) within an extended supply chain integration (SCI) (Horn et al., 2014, Zhao et al., 2011), limited research has been conducted so far to investigate the means to nurture this scope of integration (e.g. Pagell, 2004, Basnet and Wisner, 2012). Especially, research is largely devoted to conceptual studies (Lunn, 1997, Van Hoek et al., 2008) and theory building (e.g. Pagell, 2004), while theory testing has remained underdeveloped (Murphy and Poist, 1992, Mollenkopf et al., 2000, Hansen and Nohria, 2004). A great deal of research has explored the implications of integration for performance objectives (e.g. Braunscheidel and Suresh, 2009, Koufteros et al., 2010, Zhao et al., 2011), and research evidence shows that supply chain (SC) visibility and responsiveness issues are associated with the lack of well-integrated internal supply chain (SC) (Fletcher et al., 2013). A common trend among all these researchers is that they are focusing on a particular function (s), and recent empirical evidence confirms that companies still fail to overcome cross-functional barriers (Simsarian Webber, 2002, Lambert

et al., 2005, Msimangira, 2014) and functional silos mentality yet exerts significant challenges to adopt practical solutions for II (Barrat, 2004, Bakker et al., 2012). As a result, many II efforts still fail and are accompanied by organisational disadvantages. Additionally, an extensive use of technological factor as a source of firms' integration has marginalised current theories to focus on the dynamic behaviours inherent in the context-dependent nature of integration (Narasimhan and ARAM, 2001, Pagell, 2004). This has led to its shallow conceptualisation and the exclusion of human element and its associated properties which is the centre of social capital development. In fact, this understanding that technology facilitates collaborative activities has been frequently criticised as being simplistic in the literature which argue that technology obsession could become a potential barrier to collaboration (Ireland and Bruce, 2000, McCarthy and Golicic, 2002, Pagell, 2004, Cagliano et al., 2006, Trkman et al., 2007).

One of the main reasons for failed application of integrative practices has been reported to be the lack of an effective social capital management system (Zarei et al., 2014). The typical argument goes that inter-functional relationships could land on the sole purpose of transactional advantages and turn into a disruption in the absence of a management system navigating its activities. Congruent with this argument, studies have reported on the importance of rational decision making for effective coordination and integration of various functional activities and capabilities (Jassawalla and Sashittal, 1999, Swink and Schoenherr, 2015) and improved transparency across key processes to cope with the increasing competition. Since 1980 a significant body of research has devoted its efforts to recognise and accentuate the importance of business processes within the context of integration in order to raise an awareness to the key essence of supply chain integration (SCI) (Davenport et al., 1989, Bowersox et al., 1999, Srivastava et al., 1999, Mentzer, 2001, Lambert et al., 2005). In this regard, process approach is increasingly recognised as a holistic approach to SCM integration practices in order to bridge the gap between intra- and inter-organisational supply chain (SC) members. Moreover, business processes are referred to as strategic assets in moving from traditional functional-oriented organisation to a cross-functional mode of managing the network of information and materials (Llewellyn and Armistead, 2000). In fact, it is argued that processes need to become a highly integrated interface for cross-boundary cooperation and communication in order to endure SCM issues and survive. Although, literature has advocated the concept of process approach as a significant technique in managing collaborative activities, this trend seems to have been constrained at an inter-firm level.

Profound empirical basis concerning the impact of process approach has shown multifaceted organisational benefits. An empirical study by McCormack (2001) gives direct evidence that business process orientation (BPO) reduces cross-functional conflict and

improves 'esprit de corps'. There are some indications that it positively affects business results by helping companies to manage their logistics and inventory operations (Schmidberger et al., 2009, Chikán, 2009). A recent case study by Oliva and Watson (2011) into managing supply chain (SC) planning process demonstrated that the implications of process approach goes beyond simply the coordination of information flow and further serves information processing capabilities as well as problem-solving requirements for managing demand and supply, simultaneously. Lambert (2008, p.10) provided empirical evidence that "the structure of activities within and between companies is a cornerstone of creating unique and superior supply chain [SC] performance" and reinforced process view as an integration mechanism to structure SC activities. While, review of the literature uncovers the merits of a process-oriented organisation at an intra-firm level, the effect of business process orientation (BPO) on internal integration (II) is yet to be investigated. The identification of such link based on empirical evidence can provide a better understanding of how process approach can serve integration at intra-firm level, while also address the limitations of earlier studies which overlooked the relevance of business processes in their theorisation.

Besides, research has long suggested that firms need to simultaneously involve in decision making in three keys areas of process, product and supply chain (SC) (Fixson, 2005, MacDuffie, 2013). These decisions cover both strategic and operational aspects of a business and entail the design of processes and their operations across the three domains. Decisions at product level are particularly crucial in a sense that their consequences are extensive and encompass the entire product lifecycle, i.e. from conception to production to product retirement. Within this product domain, product architecture plays a key role in defining the collaborative nature of the value chain activities (Park et al., 2009). According to Fujimoto et al. (2001) product architecture is defined as the basic design philosophy which determines the division of component parts, their functions and their complex interfaces. Due to an increase in globalisation and competitive pressure product architecture is increasingly recognised as a key element in the supply chain (SC) design aspects (Pashaei and Olhager, 2015). As a response to its practical relevance, there has been a growing interest among researchers, in recent years, who have studied the association between product architecture characteristics and integration strategies in the supply chain (SC) (e.g. Park et al., 2009, Lau et al., 2010a, Jacobs et al., 2011). However, little attention has been paid to understand collaborative pattern within a firm from the standpoint of product architecture.

An important classification of product architecture which has been the topic of interest when it comes to integration is modularity (Fine et al., 2005, Antonio et al., 2009). Products with modular architecture are characterised by components that are decomposable and transferable, have standardised interfaces and also a clear and unique functionality within a product system (Antonio et al., 2009). While it entails many potential benefits, product



modularity (PM) has emerged as a matter of debate due to its substantial influence on the SC environment (Lau et al., 2010a). The degree of product modularity (PM) which lies along a continuum represents a dynamic issue in the degree of interdependence across the SC (Mikkola, 2005). Research seeking to examine this dynamic has mainly followed the logic of the 'mirroring hypothesis' which "predicts that organisational ties within a project, firm or group of firms (e.g. communication, collocation, employment) will correspond to the technical dependencies in the work being performed" (Colfer and Baldwin, 2016, p.709). The concept of product modularity (PM) permits a more precise statement of the mirroring hypothesis. Indeed, modularity at a component level may generally promote a modular organisational structure to support its activities which may have a bearing on the degree of coupling across the organisational ties (Colfer, 2016).

Previous studies have broadly drawn on the mirroring hypothesis to explain the causation for the effect of product modularity (PM) on organisational ties (e.g. Fine, 1998, Schilling, 2000, Baldwin and Clark, 2000, Sosa et al., 2004, Mikkola, 2006). In this regard, it has been argued that the need for extensive communication and cooperation may be diminished as a result of high modularity. In fact, PM allows for division of labour by grouping product development teams on the basis of their expertise and as such reduces repetitive and redundant cross-boundary communication (Hoetker, 2006). Following the logic of the mirroring effect, such segmentation may pose limitations for a process-oriented organisation due to the need for restructuring the value-adding activities. This phenomenon has been identified to have detrimental effect, particularly, in complex and dynamic business environments (Henderson and Clark, 1990, Chesbrough and Kusunoki, 2001). In essence, PM could alter organisational design and tasks structure through determining the communication pattern of the involved team (Colfer, 2007, Colfer and Baldwin, 2016). Although this seemed to be a prevalent pattern, a separate school of thought has emerged that offers a contrasting argument (e.g. Mihm et al., 2003, Sosa et al., 2004). They contend that to handle knowledge asymmetries in dynamic environments cross-boundary communication is augmented. At face value, both lines of argumentation seem to acknowledge that decisions made at strategic or operational level may be enabled or inhibited by product architecture decisions, yet they differ in the influence of the role of product architecture.

While, the relevance of modular product architecture for organisation structure and coordination mechanisms has been highlighted by past research, their arguments lack empirical support (Fine et al., 2005, Howard and Squire, 2007). An exception is a recent study by Lau et al. (2010a) in which they observed diverse patterns of PM implications for integration. Their findings suggested that the ways in which PM is connected with the level of integration do not follow a direct relationship but involve some degree of complexity. However, it is not yet known whether product architecture (PM) creates a form of

misalignment between the structure of value-creating processes and coordination mechanisms/patterns. In light of such knowledge gap, research has called for revising the concept of PM in the value-chain. Therefore, a comprehensive theorisation of internal integration (II) requires the incorporation of the dimensions of product architecture characteristics as well as process approach given the dependencies across their corresponding decisions areas. Understanding the interplay between these dimensions is particularly importance to uncover how the relationship between business process orientation (BPO) and internal integration (II) is influenced under the condition of modularity. Thus, this research builds on those studies which have come to terms with the implications of product architecture for the value-chain design decisions and seeks to investigate how modularity may influence the effect of BPO on II.

## **1.2. Research Questions (RQs) and Objectives**

This research aims to develop a multi-dimensional model of internal integration (II) and examine the interplay between process approach and product architecture. In doing so, it attempts to answer the following three questions:

**RQ1:** *“What is the relationship between business process orientation (BPO) and internal integration (II)?”*

**RQ2:** *“To what extent taking a process-oriented approach could provide a dynamic basis underlying internal integration (II)?”*

**RQ3:** *“Does product modularity (PM) moderate the relationship between business process orientation (BPO) and internal integration (II)?”*

As such, it is conducted to address three objectives as follow:

- A. To develop alternative competing models, and empirically assess the relationship between business process orientation (BPO) and internal integration (II) and thereby identifying the most well-established model, given that this research is at its early stage (of preliminary nature)
- B. To study how product modularity (PM) moderates the relationship between business process orientation (BPO) and internal integration (II) in a complex manufacturing environment, thus shedding more light on the implications of modularity for integration.
- C. And, lastly, to develop a theoretical model grounded on the first two objectives in order to further expand the existing research on integration, and therefore advance the current knowledge and perception on the means to exercise already existing integrative practices and achieve an effective internal integration (II).

### **1.3. Research Significance**

This thesis seeks to provide a new theoretical understanding that helps to explain previously confusing results and opens new insights into the concept of internal integration (II) that limited research has addressed. By bringing together previously disparate streams of work, this helps to shed light on an intra-firm level of integration which can lead to a better development of other dimensions of integration, i.e. supplier and customer integration (external integration), across the supply chain (SC). The key academic and practical significance of this research is proposed as follows:

- This research is the first academic attempt towards theorising internal integration (II) from a process perspective. As such, it makes significant contribution to the fields of operations management (OM), supply chain management (SCM) and business process management (BPM) through investigating the application of process approach in developing cooperative orientation and communication across an organisation's functions.
- By taking a contingency theory (CT) and drawing on the competing model approach, this research proposes three alternative models, and by doing so it sheds light on the most superior configuration of business process orientation (BPO) which best predicts internal integration (II). Results provide empirical support for our theoretical lens by demonstrating that the distinct models exert different effects on integration in high- and medium-tech manufacturing firms. Our findings, therefore, reinforce the significance of competing model approach and emphasise that contribution to theory development could be optimised in multiple contexts through the comparison of alternative models.
- This research supports the extant literature on the multi-dimensional nature of internal integration (II), thus builds on the behavioural and relational aspects of integration highlighted by a recent research stream. It is, therefore, a response to large body of research emphasising the significant role of human element in integrative practices.
- By incorporating product architecture standpoint into our theory development, this research takes the first step to account for the implications of product domain decisions and integrate it with decisions made within process and supply chain (SC) areas in the supply chain integration (SCI) context. Thereby, it makes a unique contribution to the management literature on the role of product architecture in SC decisions. Particularly, it provides empirical evidence on the association between modular product architecture and integration in different directions and suggests the multifaceted consequences of product modularity (PM) for the BPO-II relationship.
- By analysing product modularity (PM) moderation effect, this research provides the opportunity to identify the synergies between PM and BPO which should be considered by high- and medium-tech manufacturing firms in order to achieve an effective II. Our

investigations into this area reveal that building process approach using the concept of business process orientation (BPO) and following the logics of modularity as a product property may contribute to more deliberate decision-making concerning integration within a firm boundary.

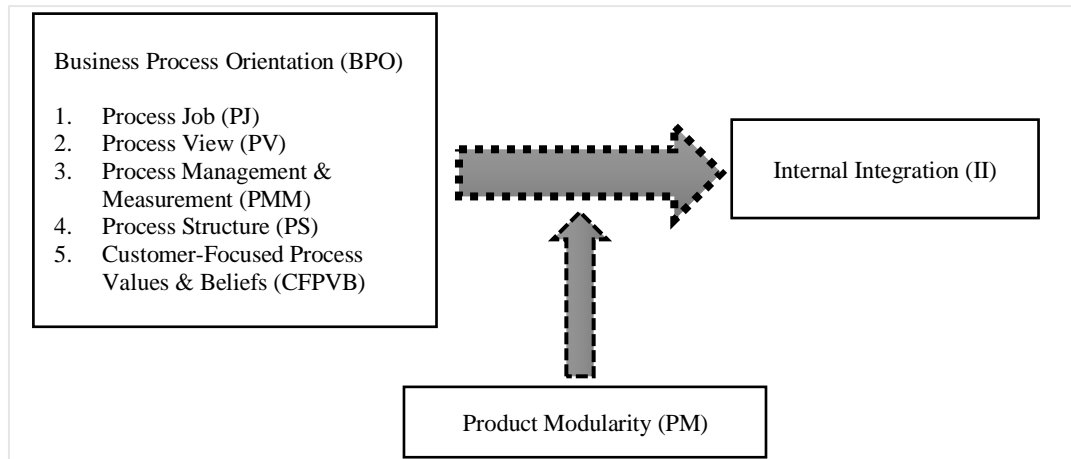
The findings in this research merit special consideration in managerial decision making and structural issues in complex and dynamic manufacturing firms.

- This research provides a model for internal integration (II) driven by a process approach that offers practical solutions to firms for managing integration across multiple functional areas. Managers may use the framework as an initial guideline to enhance their supply chain (SC) visibility by focusing on process-approach decisions critical for the development of different aspects of II. The proposed model may also be used to break the functional silo which still appears to be the dominant approach in many firms.
- The model informs business decision makers about the multifaceted managerial benefits of process approach and how a process-based organisation can provide an environment that is a catalyst for better cooperation and coordination of knowledge and information and create strong social connections between employees.
- Further it provides interesting insights into the role of product architecture characteristic and how it may reshape the decisions in process and supply chain (SC) domains. In particular, it helps managers to focus on key practices during product architecture process to best serve intra-firm integration objectives. The adoption of product modularity (PM) in this research informs managers of both downsides and benefits of modularity in relation to internal integration (II) in dynamic business environments. In particular, it highlights the appropriate mix of product modularity (PM) and business process orientation (BPO) practices to achieve the most effective II and as such improve their integration capabilities over time.

#### **1.4. Research Theoretical Framework**

It is argued that as operations management (OM) best practices have become mature, research has begun to shift from the justification of the value of those practices to the understanding of the contextual conditions under which they are effective. Therefore, this research adopts a contingency theory (CT) since research interest has begun to shift from justifying universal integrative practices to understanding the contextual conditions in which they are appropriate (Sousa and Voss, 2008). As illustrated in Figure 1.2, this research develops a conceptual framework informed by the most extensive definition provided by McAdam and McCormack (2001). The research employs the five most common dimensions

initially proposed by McCormack (1999) and operationalised later by other scholars. As such, the impact of business process orientation (BPO) dimensions on internal integration (II) is empirically investigated. In addition, this research examines if the strength of this relationship is contingent on the level of product modularity (PM).



*Figure 1.2. The Research Conceptual Framework*

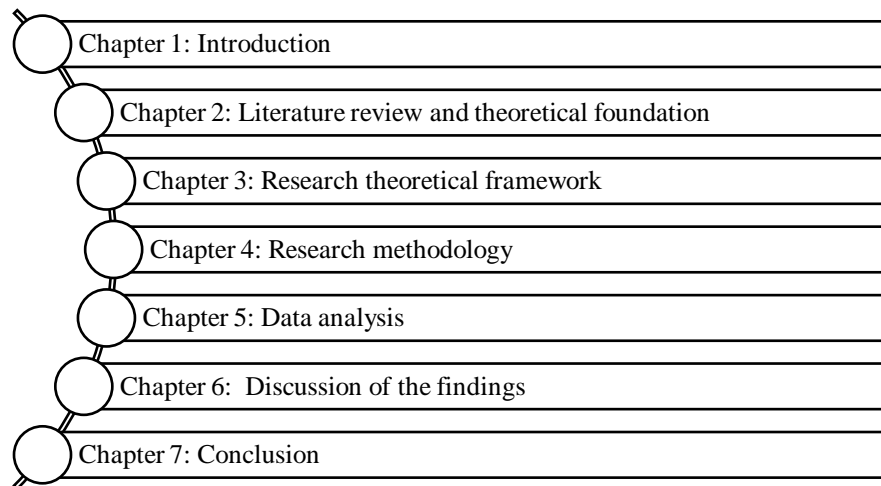
### **1.5. Research Methodology**

This research adopts a deductive critical realist approach to identify the causal relationships under investigation. Critical realist approach is receiving increasing attention in operations management (OM) and supply chain management (SCM) research due to the current state of theory building in these domains, which calls for an enhanced understanding of causal relationships underlying complex and dynamic aspects of business processes (Rotaru et al., 2014, Eriksson, 2015a). In developing the theoretical framework this research adopts three latent variables (i.e. business process orientation (BPO), internal integration (II), and product modularity (PM)) which are influenced by social aspects of a business environment. Thereby, taking a critical realist approach provides some degree of flexibility to draw causal conclusions, and helps to explain the empirical findings. It also accounts for the context-dependent nature of the research constructs (Ravesteyn, 2009, Turkulainen and Ketokivi, 2012, Vom Brocke et al., 2016). Furthermore, it is an appropriate philosophical standpoint given the preliminary nature of this research where the results are not conclusive and need to be verified. The use of deductive logic to theory testing which entails a subjective approach to social actors allows to overcome the inherent dynamic and complexities in high- and medium-tech manufacturing firms in true interpretation of the relationship under this research (Saunders, 2012). The proposal of research hypotheses followed the formulation of the research theoretical framework. A survey mode of enquiry (online questionnaire) was adopted

for data collection. The research begins by conducting a pilot study with academic and field experts for the purpose of refining and enhancing the reliability and validity of the questionnaire. The refined questionnaire was created on an online platform (Qualtrics) and then distributed to a random sample of five high- and medium-tech manufacturing sectors in the UK. A quantitative approach using regression analysis and structural equation modelling (SEM) technique was adopted to test the research hypotheses.

## 1.6.Thesis Structure

This section aims to present the structure which is followed in this research, as demonstrated in Figure 1.3, in an attempt to address the main research objectives. The concepts discussed in each chapter are briefly outlined.



*Figure 1.3. Thesis Structure*

The first chapter presented the introduction to this research. Relevant research background was provided in the context of operations management (OM), supply chain management (SCM) and business process management (BPM), followed by highlighting the gaps in the academic literature. The research questions and objectives were proposed drawing on the literature review. This chapter also outlined the research significance and research theoretical framework, and a summary of the methodology adopted to conduct the research was later discussed.

Chapter Two is concerned with providing the theoretical foundation of the concepts under this research. The chapter begins by presenting a theoretical background of SCM in relation to supply chain integration (SCI) and particularly internal integration (II). The chapter reviews the scope of integration with special focus on its multi-dimensionality. It continues on discussing a process-oriented approach which has a long history in SCM practices as a key

technique in managing cross-functional relationships. As such, the concept of business process orientation (BPO) is introduced as the means which provides the management tools to develop II. The chapter further discusses the significance of product modularity (PM), which is commonly adopted with integration as the two sources of competitive advantage, in studying organisational design. The chapter concludes by providing a comprehensive list of the research gaps.

Chapter Three proposes the research theoretical framework informed by the literature and the assumptions underlying the contingency theory (CT). The chapter starts by providing a theoretical background on the use of CT in the literature. Using competing models approach, three alternative models are developed to capture the true representation of the BPO-II relationship. In addition, PM is incorporated to the theoretical framework to explore the moderation effect of modular product architecture on this relationship. As such, relevant hypotheses are developed to examine the proposed direct, mediating and moderating relationships amongst BPO, II and PM.

Chapter Four concerning the research methodology, aims to present the transformation process from a theoretical point of view into a piece of research that is methodologically appropriate to investigate the concepts under study. This chapter draws on the philosophical and methodological approaches taken in this research, focusing on research philosophies, logic of theory testing, and research strategy. It further presents the research context, underlining the significance of II in high- and medium-tech manufacturing firms. Based on the research approach, the data collection method (online questionnaire) and its appropriateness to the purpose of this research are discussed. Additionally, scales operationalisation of the key research variables and survey administration process are presented. The chapter closes by drawing on the importance of ethical consideration and the techniques employed to ensure participants confidentiality and anonymity.

In Chapter Five survey data are examined through conducting a series of arithmetic tests. Prior to the main statistical analyses, the appropriateness of the data is examined. This entails preparing and validating the data collected by checking data quality, dealing with missing data, non-response bias and sample representativeness. In order to ensure the validity and reliability of the research constructs and their measurement models, exploratory and confirmatory factor analysis tests are carried out, followed by some further examinations of the measurement errors. The chapter then examines the research theoretical framework through testing the hypotheses, using multiple regression analysis (MRA) and structural equation modelling (SEM). The key empirical findings are then reported and discussed from statistical point of view.

In Chapter Six detailed discussion on the research findings is provided. The revised theoretical framework informed by statistical data analyses is first provided. The chapter then

focuses on providing a detailed discussion on each hypothesised relationship, with the aim of answering the research questions. The chapter ends by presenting some tentative explanations for insignificant findings.

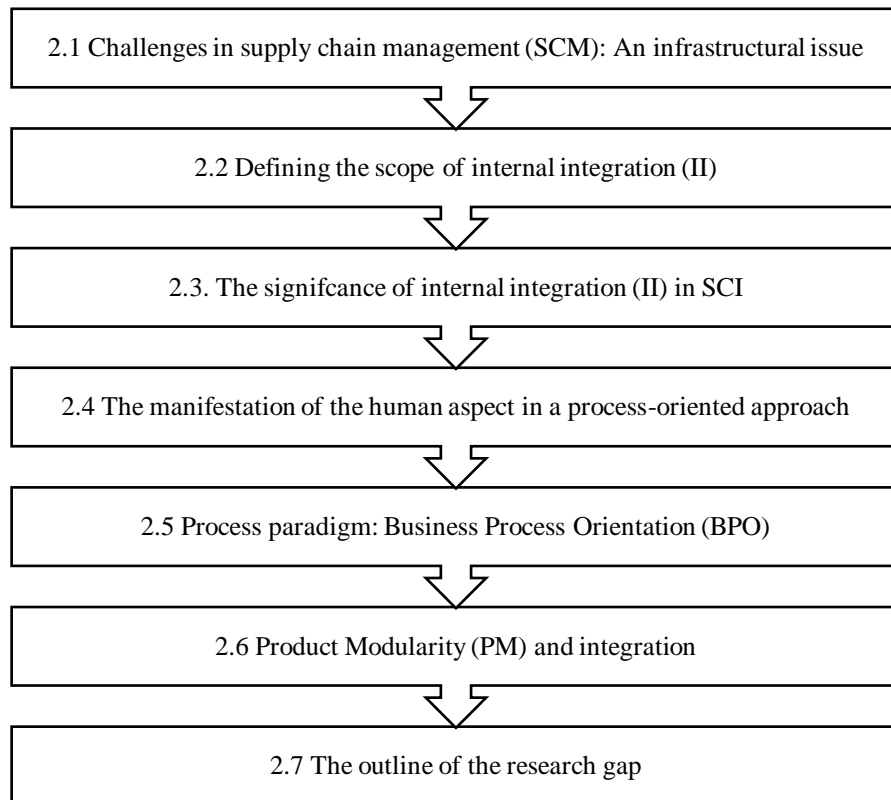
And, lastly Chapter Seven presents the conclusion of this research. The key research findings are first outline briefly. Later, the key theoretical contributions to the extant research in supply chain management (SCM), operations management (OM) and business process management (BPM) are underlined. The chapter closes by identifying the research implications for practice, and limitations of the research are addressed as implicit opportunities for future research.



## Chapter Two: Literature Review and Theoretical Foundation

### 2. Introduction

This chapter presents the scope of the research by developing a theoretical understanding of internal integration (II) through its association with a process oriented organisational design and the implication of a modular product architecture on this relationship. Figure 2.1 outlines the structure of the chapter beginning by contextualising the significance of integration in supply chain management (SCM) research. It continues by providing an extensive review of the key themes and definitions emerging from the literature focusing on II conceptualisation. The significance of II in supply chain integration (SCI) is then examined followed by underlining the fundamental role of human element in II conceptualisation. The concept of business process orientation (BPO) and product modularity (PM) are then presented with a focus on rationalising the main objective of this research. The chapter is then completed by providing a summary of the research gaps drawing on the literature review.



*Figure 2.1. Summary of Chapter Two Structure*

## **2.1.Challenges in Supply Chain Management (SCM): An Infrastructural Issue**

It has long been argued that in an era in which the nature of competition is changing from firms superiority to their supply chain (SC) competitiveness the top challenges faced by fast-growing companies is to achieve streamlined SC through increased end-to-end visibility (Fawcett and Magnan, 2002, Das et al., 2006). Although, theory has advocated that collaborative cooperation is an ideal SCM, it has barely materialised in current practices, perhaps due to a void in practical understanding of the existing theoretical concepts. Without establishing an end-to-end transparency, firms will face difficulties in managing an intricate network of business relationships across the entire SC (Fawcett and Magnan, 2002, Das et al., 2006). While optimum performance has been recognised to lie at the heart of SCM (Van Hoek, 1998, Baker, 2006), SCM is also broadly articulated as a function of integrating internal and external capabilities to achieve an extended supply chain integration promoting inter-supply chain competition (Freeman and Cavinato, 1990, Ellram and Carr, 1994, Gadde and Håkansson, 1994, Alvarado and Kotzab, 2001, Yeung et al., 2009, Flynn et al., 2010, Alfalla-Luque et al., 2013, Kotzab et al., 2015, Monczka et al., 2015). Despite all the efforts made into understanding the merits of SCM “the new orthodox of supply chain management [...] is in danger of collapsing into a discredited management fad unless a reliable conceptualisation base is developed” (Chen and Paulraj, 2004, p.120). Thereby, the academic literature is in need of advancing SCM conceptualisation which would only be possible through drawing upon its underlying practices entailing both internal and external resources and capabilities (Stock and Boyer, 2009).

SCM as a management phenomenon seeks to synchronise value-added activities and create an alignment between functional expertise to constantly satisfy and retain valued customers. To this end, companies need to close the gaps existing both internally between functional areas and externally across their supply chain partners (Fawcett and Magnan, 2002, Cagliano et al., 2006). For example, Cagliano et al. (2006) showed that companies usually fail to pay enough attention to an extended supply chain integration, leading them to focus largely on enhancing external supply chain relationships. The lack of attaining an extended SCI has been frequently associated with one of the main domains of SCM practices (Cagliano et al., 2006, Poirier et al., 2008, Schoenherr and Swink, 2012) as II “[which] was identified as the crux of supply chain initiatives” (Fawcett and Magnan, 2002, p.344). This is markedly a surprising observation, especially in light of the frequent empirical evidences suggesting the strategic importance of II as the critical antecedent of an extended supply chain integration (Braunscheidel and Suresh, 2009, Koufteros et al., 2010, Zhao et al., 2011, Barratt and Barratt, 2011, Horn et al., 2014). While this may indicate that firms have realised the significance of

internal element of SCI, the means to achieve that integration have raised many questions (Braganza, 2002, Pagell, 2004, Basnet and Wisner, 2012), furthering the lack of a clear understanding of the nature and scope of II (Braganza, 2002, Pagell, 2004). This has been attributed to the overemphasis on the performance benefits of II that prevails in the existing literature (Basnet and Wisner, 2012, Basnet, 2013). As a result, the existing practices are either not comprehensive or not well-perceived by practitioners (See Bakker et al., 2012), so further examination of II is required, going beyond the simplistic perception of solely implementing technological and information integration (Pagell, 2004, Cagliano et al., 2006).

It is argued that one of the challenges facing organisations is to advance their operational and strategic effectiveness of their supply chain through developing internal and external integrative capabilities (Richey Jr et al., 2010, Kotzab et al., 2015). This entails the development of internal and external management resources facilitating the execution of SCM in order to gain competitive advantages (Kotzab et al., 2015). Internal resources are manifested in various activities embracing both soft (e.g. trust, commitment, accountability, etc.) and hard (e.g. financial and human resources) factors that lie within an organisation (Mentzer, 2001, Olhager, 2002, Hsuan Mikkola and Skjøtt-Larsen, 2004, Kotzab et al., 2006, Yeung et al., 2009). Empirical evidence has shown that internal capabilities are significantly dependent on the successful implementation of key business processes and could be developed and delivered by an effective management of their execution (McAdam and McCormack, 2001, Movahedi et al., 2016). In particular, the importance of key business processes is gaining substantial attention in managing the integration of value-added activities among both academics and practitioners (Hernaus, 2008b). For example, Fawcett and Magnan (2002) found that modelling internal business processes can greatly contribute to managing external relationships with both customers and suppliers, while also result in a well-grounded understanding of the core supply chain processes. The key objective is to achieve an end-to-end transparency, and thus improved collaboration across the value-added activities (Fawcett and Magnan, 2002).

It is then evident that the key business processes have a central role in attaining integration. To yield optimum benefits it is suggested that firms should align their integrative needs with their strategies derived from their key business processes (Cagliano et al., 2006). The management of key business processes, which have also been referred to as SCM-related processes, is argued to be the primary driver of supply chain integration (Alfalla-Luque et al., 2013, Kotzab et al., 2015). In addition, as proposed by Kotzab et al. (2006) there are linkages between SCM execution and SC processes which could effectively result in stronger relationships established across the SC members. This in turn could promote joint network management by which the underlying needs for shared value creation is provided. As a result, the involved firms could exalt their competitiveness in the market (Olhager, 2002). Despite

being at the heart of SCI, only recently the strategic role of business processes approach has attracted some theoretical attention among academics (e.g. Lambert, 2008, Chen et al., 2009b, Eriksson, 2015b). As such, the role of a process-oriented approach in promoting an effective SCI remains unclear to a large extent. Therefore, in an attempt to develop a conceptual framework, this research focuses on the notion of business process orientation (BPO) within the domain of internal integration (II). The next section will discuss the scopes and definitions of integration operationalised by many past scholars, followed by an argument on the lack of a clear understating of II.

## **2.2.Internal Integration (II): Scope and Definition**

A substantial research stream has been dedicated to SCI and its conceptualisation. Yet, empirical findings have been mixed in terms of characterising II as a key element of SCI (Braunscheidel and Suresh, 2009, Koufteros et al., 2010, Zhao et al., 2011). While a large body of literature has focused on SCI over the last decades, it is only recently that II has substantially received attention from researchers in the SC context (Braganza, 2002, Pagell, 2004, Barratt, 2004, Bakker et al., 2012, Basnet and Wisner, 2012, Basnet, 2013, Turkulainen et al., 2017). Recognised as a pre-condition to an extended SCI (Braunscheidel and Suresh, 2009, Koufteros et al., 2010, Zhao et al., 2011, Horn et al., 2014), the scope and conceptualisation of II have raised many questions in the literature (e.g. Gimenez, 2003, Pagell, 2004, Ashenbaum and Terpend, 2010, Bakker et al., 2012, Vallet-Bellmunt and Rivera-Torres, 2013). This could be partly associated with the inherent complexity involved in integration which is also present in its origins, i.e. SCI and SCM. In addition, much of the current research has been dedicated to performance implications of II (Basnet and Wisner, 2012). Within this body of knowledge, II has been frequently treated as an organisation competency to seamlessly integrate internal operations for the purpose of achieving superior performance (e.g. Stank et al., 2001). It is also endorsed by Pagell (2004) that a great deal of research has been conducted on examining the effect of II on performance, and is deprived of a theory suggesting what constitutes its underlying basis.

Literature gives only a general understanding of II features and characterises it by terms such as information/technology sharing, joint collaboration, cooperation, communication, interaction, developing trust and partnership, etc. These features constitute the ground of integration for a dramatic shift from the management of functional processes independently, to an intra-organisational cross-functional approach which allows for managing processes as an integrated chain (Akkermans et al., 1999, Power, 2005). However, the presence of a comprehensive framework which focuses on the means to cultivate a dynamic basis in order to exercise these practices and achieve integration is yet to be

developed. Therefore, in order to develop a better understanding of II, it is crucial to define the boundaries of integration by situating it within the broader context of SCI and comprehending its different nature from other forms of integration, such as external integration. This helps broaden our understanding and horizon regarding II which little attention has been paid to so far.

In the interest of studying the broader scope of SCI, scholars have treated integration differently, see Appendix 2.1. While some conceptualised it as a single construct (e.g. Sezen, 2008, Shub and Stonebraker, 2009), others viewed it as a multi-dimensional concept and assigned different definitions and dimensions to it (e.g. Koufteros et al., 2005, Vachon and Klassen, 2006, Flynn et al., 2010, Wong et al., 2011). As for the dimensions of SCI, the findings in the literature are contradictory, and it has been conceptualised from different and inconsistent perspectives. In contrast to some researchers which have focused on internal and external integration (Narasimhan and Kim, 2002) or on supplier and customers integration, there has been a new research stream that studied II separately (e.g. Braganza, 2002, Pagell, 2004, Barratt, 2004, Bakker et al., 2012, Basnet and Wisner, 2012, Foerstl et al., 2013, Basnet, 2013, Turkulainen et al., 2017). Although, the concept of cross-functional integration had been previously recognised in the context of new product development (NPD) (Kahn, 2001, Calantone et al., 2002, Millson and Wilemon, 2002, Koufteros et al., 2005), it was only recently that II started to receive significant recognition in the field of supply chain. So, research on this subject is still at its early developmental stage (Basnet and Wisner, 2012). Although, product development literature has greatly contributed into the examination of the manners and practices resulting in high inter-functional integration, it is argued that these practices may only be applicable to the context of product development, and not be useful in developing a strategy for II in other contexts (Pagell, 2004). This reflects the context-dependent feature of integration which has a central importance and emphasises on the need for research exception in the context of II (Turkulainen and Ketokivi, 2012).

The literature review evidently reveals that there is a lack of a general consensus among academics and practitioners conceptualising II. A recent study on internal supply chain integration also reports inconsistency in understanding and measuring the scope of integration (Basnet, 2013). A wide range of definitions and scopes have been assigned to it among which concurrent engineering (Barkan, 1992, Millson et al., 1992, Koufteros et al., 2005) has received a great deal of attention, particularly within NPD context. Although, concurrent engineering has been addressed by many scholars and practitioners, achieving its effective implementation has been reported rather disappointing. This is argued to have stem from the dearth of attention to value identification and a product-focused approach, and a rather technological orientation in process optimisation, integration and collaboration improvement (Letens et al., 2011).

Besides, some have taken a different approach and posited it as cross-functional collaboration/cooperation (Simatupang et al., 2002, Kopicki, 2002, Barratt, 2004, Pagell, 2004, Chen et al., 2007). Similarly, Lambert et al. (1998) and Chen et al. (2009b) envisaged it as the effective management of key business processes. Furthermore, II has been extensively studied within the context of information system (IS) as providing the infrastructure for information processing within and across organisations (Morash and Clinton, 1998, Narasimhan and Kim, 2002, Schoenherr and Swink, 2012). As such, despite its importance, the definition of II has remained vague (Basnet and Wisner, 2012, Frankel and Mollenkopf, 2015). There is also a common trend among some papers which focus on the scope of integration and tend to confine the practice of integration to certain functions. These studies usually examine a particular function, e.g. purchasing, logistics, etc., and their practices employed to integrate with other functions (e.g. Narasimhan and ARAM, 2001, Primo, 2010). In light of this outlook, some other studies take a more open-minded approach and examine dyad interaction and their interfaces (e.g. Hayes and Wheelwright, 1984, Stock et al., 1998, Verma et al., 2001, Narasimhan and ARAM, 2001, Gimenez, 2003, Chen and Paulraj, 2004, Gimenez and Ventura, 2005, Gimenez, 2006).

By virtue of this approach, this research stream tends to conceptualise II from a functional perspective, e.g. logistic perspective (Gimenez, 2006). What is not considered in these studies is treating II as being influenced by the participation of all entities working under the same umbrella, not only a pair of entities. This tendency in studying established dyad relationships is likewise criticised by Oliva and Watson (2011) who argue that the advantages acquired by co-involvement of multiple functions in SCM practices could be hampered by the lack of their active presence. This lack is seen both across different disciplines among academics as well as in practices across functional entities which tend to remain silos. Therefore, this predominant dyadic approach could be argued to have contributed in delaying the development of an overarching theory manifesting the role of several functional entities (Fawcett and Magnan, 2002) which could enhance the understanding of an organisation structure and lead to an improved customer satisfaction (Birou et al., 1998, Morash and Clinton, 1998).

Despite the wide range of definitions provided, the core theme emerged from the literature defines integration as interaction and collaboration among departments which involve joint works and activities in order to achieve unity of purpose (Kahn, 1996, Ellinger, 2000, Vallet-Bellmunt and Rivera-Torres, 2013). By definition, interaction refers to the patterns which cross-functional relations are formed around, and thus represents the structural aspect of integration. While, collaboration connected with emotions is concerned with individuals attitude, tendency and orientation to develop common goals, shared vision, trust, etc. beyond their functional boundaries. It is argued that these two key ingredients of

integration are intangible and require strenuous efforts to be developed, regulated and maintained (Kahn, 1996, Vallet-Bellmunt and Rivera-Torres, 2013). As a core topic in SCI, II involves both strategic and tactical decisions centred around a core purpose of unity across departments/business units. Vallet-Bellmunt and Rivera-Torres (2013) and Kahn (1996) suggest that II encompasses both behavioural and relational grounds where behavioural aspect meets the transactional requirements, while relational element emphasises on cultural behaviour which is a driving force of a continuous relationships. The distinction between the two collaborative and interactive approach is explained by their underlying philosophies pertaining to non-transactional and transactional-based relationships, respectively (Vallet-Bellmunt and Rivera-Torres, 2013). For example, Teigland and Wasko (2003) suggest that collaboration is required for individuals who are willing to integrate knowledge across functions. At the same time, following financial incentives interaction may be formed among them leading to resource competition (Vallet-Bellmunt and Rivera-Torres, 2013).

According to Zhao et al. (2011) collaboration within a firm boundaries is an integral part of II thus, “firms achieving high levels of integration often deploy intra-organisational cross-functional [collaboration] to merge traditional functional practice into a simplified, manageable process” (Stank et al., 2001, p.39). It helps develop the culture of shared resources and joint goals. Recognised as the attitudinal aspect of II, this collaborative approach, promotes a common vision among functions. The collaborative approach focus is mainly on developing ‘*esprit de corps*’ between functional areas, as oppose to forming information linkages (Kahn, 1996). ‘*Esprit de corps*’ is defined as “the extent to which a team spirit [is] prevailed in the organisation” (Jaworski and Kohli, 1993, p.60). If well-developed, this would lead to team-establishment with shared responsibilities and facilitate cross-functional integration, while also increase cohesion and cross-functional commitments (Salojärvi and Saarenketo, 2013).

Equally important, interaction seems to be the minimum requirements of II (Basnet, 2013). The construction of interaction on a company-wide basis demands extensive information exchange and inter-departmental communication (Topolšek and Orthaber, 2011). Transaction-based communication is central to this interactive approach (Kahn, 1996) “which defines departments as mutually dependent entities” (Topolšek and Orthaber, 2011, p.190). Resting on this interactional philosophy, inter-functional integration may be perceived as temporary and built merely on data exchange. As such, a network of interdependent members is formed who primarily seek to obtain information from their counterparts in order to meet their needs (Topolšek and Orthaber, 2011). Without having the willingness (collaborative intention) to continue this interaction on an ongoing basis, inter-functional integration could fail (Topolšek and Orthaber, 2011). Therefore, both collaborative and interactive approaches are the key requirements of integration and greater success can be achieved by their joint

incorporation than in isolation (Kahn, 1996, Vallet-Bellmunt and Rivera-Torres, 2013). In line with this claim, an effective II has been frequently viewed as a sum of both collaboration and interaction (e.g. Gupta et al., 1985, Song, 1991, Song and Parry, 1992, Thomas, 1992, Kahn, 1996, Kahn and McDonough, 1997, Ellinger, 2000, Pagell, 2004).

### **2.2.1. Multi-Dimensionality of Integration**

Over the past 10 years a considerable amount of literature has emerged around the theme of SCI and treated it as a one-dimensional concept. Recent literature review indicates that results regarding SCI dimensionality are different and not very convincing (Fabbe-Costes and Jahre, 2007, Vallet-Bellmunt and Rivera-Torres, 2013). Despite many past inconsistent approaches regarding the dimensionality of integration, it is suggested that integration cannot be measured as a one-dimensional construct, but it is a multidimensional notion that is structured into three classifications, namely attitude, patterns and practices. Each category deals with a varying level of an organisation, including corporate, strategic and operational levels (Vallet-Bellmunt and Rivera-Torres, 2013). In a similar vein, Barki and Pinsonneault (2005, p.172) operationalise integration to include operational and functional integration, each of which is facilitated by a number of mechanisms, e.g. “planning and direct supervision, standardisation of output, and standardisation of work processes” and “standardisation of norms, skills, and knowledge”, respectively.

In exploring the key aspects of integration, this research came across a sheer number of dimensions corresponded to cross-functional integration. With his enormous contribution to the literature Pagell (2004) has conducted the most inclusive study of the factors enabling and inhibiting II, focusing on contextual elements. His preliminary investigation into the development of a model of II resulted in an eight-factor theoretical framework. The factors include *structure, culture, consensus, communication, measurement, facility layout, job rotation, and cross-functional teams*. For example, *structure* is concerned with “the formal reporting relationship, grouping and systems of an organisation” (Daft, 1995, p.582). Three types of structure, i.e. centralised, focused factory, and matrix structure, were examined among which matrix structure was the only enabler of II. The key indication is that organisational structure needs to streamline the movement of products and services between functions across an organisation. *Culture* is concerned with the values and beliefs shared between a company members. The aspects of *culture* that foster teamwork and openness create an environment in which high integration is achieved as opposed to blaming culture which is counterproductive.

Pagell’s work has provided the ground for theory development for a number of researchers in a similar context (e.g. Chen et al., 2009b, Flynn et al., 2010, Braunscheidel et al., 2010, Zhao et al., 2011). Under his contextual perspective, they have come to define



integration from different perspectives. For example, Frohlich and Westbrook (2001) studied operational aspects of integration. Flynn et al. (2010) and Huo (2012) also focused on the strategic scope of integration and defined integration as strategic collaboration across supply chain members and inter/intra-organisational business process management (BPM)<sup>1</sup>. Lockstroem et al. (2010) clustered integration dimensions into three groups to which the effect of integration on performance was evaluated. The classification includes relational, information, and operational integration. And in a more general sense, Leuschner et al. (2013, p.34) suggest that integration should be characterised as “the scope and strength of linkages in supply chain processes across firms”, which have also been empirically explored by Frohlich and Westbrook (2001), Fawcett and Magnan (2002) and Flynn et al. (2010).

Scope of integration concerns suppliers, customers, internal, and external integration. And, strength is concerned with the degree of relational, information, and operational integration. Relational dimension is assigned to corporate philosophy and is related to attitudes (Maloni and Benton, 2000, Shin et al., 2000, Jayaram et al., 2004, Johnston et al., 2004, Fynes et al., 2005). Information integration, which is a tangible aspect of integration (Vallet-Bellmunt and Rivera-Torres, 2013), is linked to integrative practices. And, operational integration “refers to the collaborative joint activity development, work processes and coordinated decision making among firms in the supply chain” (Leuschner et al., 2013, p.38), and is associated with the patterns of collaboration between departments at an internal level (Stank et al., 2001, Stanley and Wisner, 2001, Gimenez, 2003, Gimenez and Ventura, 2005, Baker, 2006, Vallet-Bellmunt and Rivera-Torres, 2013). The definition of relational, information and operational dimensions is in line with Van der Vaart and van Donk (2008)’s study in which they analysed 33 papers and conceptualised integration into three dimensions of *practices*, *attitudes*, and *patterns*. These three dimensions were examined and validated later by Vallet-Bellmunt and Rivera-Torres (2013) in a survey-based study carried out in material suppliers’ companies. *Practices* refers to the activities performed, and technologies employed to facilitate SC members interaction such as deliveries synchronisation and the application of Electronic Data Interchange (EDI). *Attitudes* is defined as the members approaches and orientation towards their interaction and with regards to integrative practices. Commitment and trust are some of the examples. And, *Patterns* concerns the organisations of interactive and collaborative activities between the members of supply chain (Vallet-Bellmunt and Rivera-Torres, 2013).

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<sup>1</sup> BPM is “a holistic organisational management practice, which requires top management understanding and involvement, process-aware information systems, well-defined accountability and a culture receptive to business processes. It is based on process architecture, which captures the interrelationships between the key business processes and the enabling support processes and their alignment with the strategies, goals and policies of an organisation” (Rosemann & De Bruin, 2005, p. 2)

In light of a recent trend, behavioural and structural factors have emerged as the two critical II dimensions forming the underlying basis of business functions communication and interaction (Pagell, 2004, Bakker et al., 2012, Msimangira, 2014, Abualrejal et al., 2017). It is identified that communication in organisations equipped with functionally oriented cultures and structures is impeded across business functions, and sub-optimisation is more likely to occur within the functions (Pagell, 2004). Hereby, culture, structure and communication are affected by each other to a degree that one could hamper the effect of the other if their configurations are not aligned towards the same goals. This is when the *consensus* factor suggested by Pagell (2004) comes into play which promotes “the alignment between functional strategies and business strategy” (p.476). In addition, functions physical proximity linked to organisational structure could become a barrier obstructing cross-boundary communication and interaction, through affecting shared culture and business context (Barnatt, 1995, Atkins et al., 2002, IJsselsteijn et al., 2003). Firms in such situation could find it difficult to communicate remotely due to a lack of strong willingness and cooperative approach (Bradner and Mark, 2002), and as such fail to develop mutual understanding (Connolly et al., 1990, Bradner and Mark, 2002). To ease this potential barrier, Pagell (2004) suggests the use of formal communication mechanism particularly exercised in large organisations where informal communication is not feasible due to their operational complexities. In addition, with reference to his *measurement* factor, developing a measurement system could further mitigate the risk of incompatible behaviours and cultural conflicts, and thus create a lever for managers to enhance integration.

Although, several studies have attempted to draw on distinct, while individually critical, dimensions of II, there is still a significant gap between the theory and practice with only a handful of companies achieving an extensive II (Towill et al., 2002, Graham et al., 2005, Halldórsson et al., 2008, Bakker et al., 2012). What these studies share in common is the lack of attention to the essence of SCI which is broadly perceived as the management of a firm’s key business processes (Frohlich and Westbrook, 2001, Bowersox et al., 2002, Trkman et al., 2007). This has led to a limited research investigating the characteristics of a process approach in order to develop a comprehensive model as a means to operationalise the existing II practices. Nevertheless, the increasing adoption of a process-oriented approach in the broad domain of SCM is evident (e.g. Lindfors, 2001, McAdam and McCormack, 2001, Power, 2005, Trkman et al., 2007, Škrinjar et al., 2008, Chen et al., 2009a, Eriksson, 2015b, Movahedi et al., 2016), to an extent that some ground their definition on “an explicit process perspective” (Flynn et al., 2010, Olhager, 2002, Eriksson, 2015b, p.39). For example, in their literature review, Chen et al. (2009b) synthesised various integration dimensions and proposed two core elements of *connectivity* and *simplification*, which are considered as the two main properties of business processes (Lederer and Huber, 2014). *Connectivity* concerns the creation of a

seamless connection between a firm activities and its key objectives. In addition, *simplification* emphasises on improved efficiency and effectiveness through business process re-engineering. Indeed, simplification, being a central element in SCI context (e.g. Rodrigues et al., 2004), needs the elimination of unnecessary operations, tasks and activities (Chen et al., 2009b). Similarly, Eriksson (2015b) adopted a process perspective and determined integration dimensions in the project-based supply chains, as depth, duration, strength, and scope of integration.

The above discussion underlines the multi-dimensionality of integration, drawing a distinction between the drivers and inhibitors of an effective II. Despite the theoretical appeal of a process approach to manage supply chain practices (Lambert, 2008, Chen et al., 2009b), current literature has failed to adopt this view and develop a comprehensive theory of II. As a result, practice has seen a lack of fit between firms management strategy and the use of appropriate integrative practices (Day, 1994, Chen et al., 2009a), and as such firms attempt to integrate their internal processes with suppliers and customers have been mostly unsuccessful (Von Haartman, 2007). Therefore, this research calls into the significance of this approach in examining II and theorising it beyond the dominated dyad approach. In an attempt to determine the most appropriate definition guiding us throughout this research, we synthesise the definitions provided by Zhao et al. (2011), Leuschner et al. (2013), Primo (2010), Chen et al. (2009b), Pagell (2004), Eriksson (2015b) and Kahn and Mentzer (1998) define II as collaborative joint activity development, work processes, decision making, aligned goals/measures development, for the purpose of creating seamless processes spanning several functional entities which effectively interact and collaborate towards achieving the same goals. The key component of these activities is human factors the role of which will be comprehensively discussed later. Given that this research aims to primarily focus on intangible aspects of integration, i.e. attitudes and patterns, frequently overlooked in the past research, the informational aspect, i.e. practices, is excluded from the definition. Nevertheless, the importance of information integration is not underestimated in achieving a successful II (Vallet-Bellmunt and Rivera-Torres, 2013). Next section will elaborate on the human element of integration to further emphasise on its attitudinal and behavioural aspects (Bakker et al., 2012, Vallet-Bellmunt and Rivera-Torres, 2013).

### **2.2.2. Human Aspect of Integration**

Within the SCM field, the research has been rendered the opportunities to cover a broader scope of multiple SC aspects such as culture, values, structure, configuration, as well as the human element which is fundamental to any SC operations (Gino and Pisano, 2008, Bendoly et al., 2010, Croson et al., 2013, Tangpong et al., 2014). Although, these aspects are considered complementary and the joint adoption of their properties could have a great impact

on SC outcomes (Ellinger et al., 2006), the human element has been neglected in this domain for so many years (Bakker et al., 2012, Tangpong et al., 2014). Nevertheless, the review of literature revealed that this fundamental domain of SC is gaining back an increasing attention among researchers as a research agenda (Bakker et al., 2012), and its importance has been frequently brought to light in some recent studies (e.g. McCarter et al., 2005, Bakker et al., 2012, Sweeney, 2013, Tang et al., 2013, Tangpong et al., 2014). It is broadly accepted that previous research studies have failed to address behavioural dynamics of SC members (Storey et al., 2005, Ellinger et al., 2006, Bakker et al., 2012). In an attempt to identify the important research themes in SCM Wieland et al. (2016, p.207) acknowledged that “[SCs] are not “soulless machines”, but complex sociotechnical systems involving cognitive elements and impacted by face-to-face negotiations and conversations”. A recent empirical study on agent-system-co-development (ASC) demonstrated that there is a strong mutual relationship between SC system properties (e.g. structure, social norms) and action-influencing aspects of human element (e.g. attitude, beliefs) (Tangpong et al., 2014). The exclusion of human element and its associated properties (e.g. personalities, behaviour, cognitions, etc.) could, then, have side effects on SC system outcomes. Therefore, a further attention is deemed necessary on this abandoned element of SC research (McCarter et al., 2005).

It is argued that within the SC decision-making context, human cognitive limitations are the most prevalent barriers which tend to impose significant decision-making challenges (Wieland et al., 2016). It is naïve to disregard these limitations and assume that access to all information is immediately available and transparent to all decision makers. In such situation, traditional management approach are more likely to fail due to the behavioural dynamic of individuals which could cause complexity in decision-making and lack of visibility in information. One possible way to overcome these barriers is through the adoption of a process-oriented approach fostering a cross-functional perspective (Ravesteyn and Versendaal, 2010). To achieve this objective Palma-Mendoza et al. (2014) suggest that re-designing business processes would render appropriate foundation for the construction of SCI. However, Tang et al. (2013) examine the effect of II on organisational innovation performance and suggest that fostering integration through defining and modelling business processes does not itself lead to superior outcome. Better performance is rather the product of both jobs re-structuring as well as social network that individuals operate in (McCarter et al., 2005, Sweeney, 2013, Tang et al., 2013). In line with this, Melão and Pidd (2000, p.9) argue that viewing business process “as a transformation of inputs from suppliers into outputs to customers” without considering human element is against with what is revealed in the real world. Instead, they view business processes as collaboration network which is constituted of a sequence of activities and people involved in. It is the network of individuals that form the building block of business functions to cross-functionally interconnect and integrate (Barki and Pinsonneault, 2005, Eriksson,

2015b). This approach is supported by the sociocentric theory extensively adopted in business process redesign literature (Bashein et al., 1994, Carr, 1995), which argues that success in process re-design is the product of human-related and social aspects, such as interaction, communication, leadership, process vision, and team structure (Sarker and Lee, 2002).

Being primarily about people, integration is grounded on the relationships established cross-functionally and between individuals from different divisions. Thus, human relationships form the basis of integration (Sweeney, 2013). In line with this contention, Kogut and Zander (1992, p.384) declare that “organisations are social communities in which individual and social expertise are transformed into economically useful products and services by the application of a set of higher-order organising principles”. Human relationships across functions are established upon these principles. These principles govern integrative techniques which foster functional divisions to collaboratively share knowledge and coordinate (Rosenzweig et al., 2003). Moreover, Barki and Pinsonneault (2005) suggest that the level of individuals’ involvement in employing integration mechanisms increases when II is high, meaning that high level of integration demands higher level of contribution from the human side. Therefore, as it is evident not only a successful development of II requires further attention to human aspects, i.e. behavioural and attitudinal dimensions, but it also entails a management system that is compatible with the governance of these soft aspects of integration. In the following section, the significance of II from different perspectives is discussed, in an attempt to shed more light on the implications of II for SCI.

### **2.3.The Significance of II in SCI**

It appears that II has evolved substantially from being a technique to establish and maintain internal competencies, to become a strategy embedded in a firm SCM developments (Monczka et al., 2015). It has been frequently characterised as an underlying basis of external integration, while being leveraged as a mechanism across functional departments to boost an organisation’s performance (Graham et al., 2005, Sanders, 2007, Braunscheidel and Suresh, 2009, Koufteros et al., 2010, Zhao et al., 2011, Huo, 2012, Alfalla-Luque et al., 2013, Yu et al., 2013). Indeed, it has been viewed to mediate the effect of external integration on performance through eliminating internal boundaries between functions while also promoting collaboration and synchronisation on a company-wide basis (Jonsson et al., 2011). Therefore, many studies argue that it is of great importance to establish integration practices across business functions before initiating external integration (Flynn et al., 2010, Zhao et al., 2011). At the same time, it is also argued that, depending on the competitive priorities of a firm the implication of II could vary. For example, both internal and supplier integration appear to be most effective in functionality-focused organisations. While, a market-responsive

organisation seems to most benefit from supplier and customer integration (Von Haartman, 2007).

The link between internal integrative practices and their intra-/inter organisational influences has been substantiated in several studies. Sharing of information, as an ‘internal integrative process capabilities’, is argued to provide the basis for enhancing ‘external integrative process capabilities’ since “information exchange and a partnership atmosphere can spread from within the company to the outside and to the whole [supply chain] SC” (Huo, 2012, p.599). Similarly, drawing on ‘information processing capabilities’, Fletcher et al. (2013) suggest that, in practice, the lack of SC visibility and responsiveness is because of the dearth of II. Thus, ‘information processing and sharing capability’ as an II mechanism could expedite the alignment of functional goals, while also promoting cross-boundary association and linkages (Schoenherr and Swink, 2012). The resultant ‘internal linkages’ is indicated as a key factor affecting ‘cost containment performance’ (Won Lee et al., 2007). Through cross-functional collaboration, II also enables the alignment of goals between key functions, i.e. purchasing, planning, manufacturing, and logistics, and allows to exploit knowledge and expertise beyond functional boundaries (Pagell, 2004, Fletcher et al., 2013).

Broadly recognised as mutually inclusive (Koufteros et al., 2010), some past scholars have argued that II and external integration have a complementary relationship (e.g. Sun and Ni, 2012). Under this perspective, Rodrigues et al. (2004) suggest that in order to achieve a superior performance both internal and external integration of operations need to be in place simultaneously, given their mutual interdependencies. Stank et al. (2001) provide empirical evidence on the effect of internal and customer integration on firms performance such as delivery, customer satisfaction, responsiveness to key customers, costs, and etc. Germain and Iyer (2006) analysed the interactive effect of internal and customer integration on different aspects of a firm performance and demonstrated that II reinforces the effect of customer integration on logistics performance. Koufteros et al. (2005) suggest that II alone cannot warrant an effective SCI and the achievement of external integration is equally important. Likewise, external integration per se cannot contribute to a firm performance success, and II should also be in place. Therefore, without having either of the integration elements, a firm could fail to support its business objectives. In line with this argument, Narasimhan and Kim (2002) demonstrated that the relationship between ‘product diversification and performance’ and ‘internal market diversification with performance’ were moderated by internal and external integration, respectively. On a similar note, Rodrigues et al. (2004) suggested that either of internal or external integration in isolation does not have an impact on performance. Thereby, for integration to result in superior performance, an aggregated effect of both elements should be considered.

In addition, literature has repeatedly drawn on the key role of II as a pre-condition for integration with external members of the supply chain (e.g. Bessant et al., 2003, Rosenzweig et al., 2003, Sanders, 2007, Narasimhan et al., 2010, Flynn et al., 2010, Zhao et al., 2011, Horn et al., 2014), suggesting that it helps an organisation to absorb, establish, and maintain external integration capabilities (Das et al., 2006, Huo, 2012). Conceptually, Stevens (1989, 1990) suggested that SCI is achieved gradually through evolving from functional integration to II and then external integration. From organisational theory point of view, it is argued that II facilitates external integration initiation as it is conducive to external collaboration and exchange of information in a timely manner (Koufteros et al., 2005). Boehme et al. ( and Braunscheidel et al. (2010) state, in order to achieve seamless operations, organisations require to start from within house and integrate internally, before proceeding to integration with upstream and downstream of the supply chain. For example, “without integrative data management, firms will have little chance to share their production plans with customers or suppliers” (Huo, 2012, p.604). Therefore, a weak level of internal integrative capabilities could potentially result in an organisational shortfall to engage in meaningful external partnership and collaboration (Zhao et al., 2011).

Despite the above-mentioned theoretical and empirical evidence, a few recent studies found that the effects of II and external integration on performance are not always consistent. For example, Gimenez and Ventura (2005, p.11), viewing II from logistics perspective, contended that “[II] is necessary for external integration, but [it] does not imply external integration”. They further demonstrated that when a high external integration is in place, II has no effect on a firm performance. Similarly, in the lack of external integration, logistics-production interactions, results in a better performance, yet the integration between logistics and marketing did not reveal the same impact. This implies that, depending on the integration of different functions and also the extent of external integration, the impact of II on performance may vary. In addition, drawing a distinction between their effects on performance outcomes, it has been identified that while external integration has a major impact on time-based factors, II has shown to be more significant in less-time-dependent measures (Wong et al., 2011, Schoenherr and Swink, 2012).

The above discussion explains the implications of II for external integration; although they were not always consistent. These equivocal results provide further evidence that although, II has been the subject of a great deal of studies (e.g. Pagell, 2004, Das et al., 2006, Germain and Iyer, 2006, Alfalla-Luque et al., 2013), empirical research that presents a novel and comprehensive theory of II is lacking prominently (Fabbe-Costes and Jahre, 2008, Basnet, 2013). Therefore, this research seeks to shed new light on this area of integration mostly overlooked in SCI context, yet this is not to underestimate the importance of external integration. Given the acknowledged significance of II and the over-reliance on technology in

the domain of SC, it is paramount for current research to study integration at an intra-organisational level, while also bearing in mind that it is part of an extended SCI (Barratt, 2004).

This study aims to expand on the dyadic approach generally employed by previous research and examines II within a broader context of key business processes. Hence, the key focus in this research study will be on business processes spanning across the border of an organisation (Lambert and Cooper, 2000). Although, they are not distinct from processes extended across the supply chain (Lambert and Cooper, 2000), this research will solely focus on internal aspects of processes. Nevertheless, to enhance our understanding on the topic next section will provide a brief examination of the connection between business processes and integration, shedding more light on this relationship within an extended SC.

### **2.3.1. II and key Business Processes: A Holistic Approach**

According to Brown (2008) business processes are characterised as surrounding an extensive scope of practices carried out by organisation in order to accomplish its business goals. More specifically, they include “the value-added activities that support and facilitate the customer lifecycle, represent the foundation of most businesses and the value that customers pay for and the essence of most businesses” (McCormack and Rauseo, 2005, p.109). The core business processes executed by any organisation are ‘procurement, logistics, and distribution’, ‘operations’, ‘product or service development’, ‘marketing, sale and customer accounts’, and ‘customer and after sale services’ (Brown, 2008). While, supporting business processes, e.g. human resource management, information system, etc., includes the ones that do not directly get involved in producing value to the end customer, but still possess significant position as they support and facilitate the operations of key business processes (McCormack and Rauseo, 2005). A firm’s business processes encompass the two aspects of strategic and operational, with each aspect taking a different view to business processes (Axenath et al., 2005). Operational aspect concerns sub-processes involving the fulfilment of detailed and day-to-day activities, while strategic aspect is associated with the operations implemented at a strategic level based on a pre-defined structure. For the value adding processes to be effective and efficient an organisation needs to prevail an appropriate cooperation system managing business functions. SCM is a system utilised to integrate and manage these processes.



Since 1980 a significant body of research has devoted its efforts to recognise and accentuate the importance of integration of business processes spanning several functional units in an attempt to develop SCM framework (Davenport et al., 1989, Bowersox et al., 1999, Srivastava et al., 1999, Mentzer, 2001, Lambert et al., 2005). For example, Hammer (2001) asserts that the nature of SC business processes is cross-functional and a real success lies in their effective integration. In line with this contention, two fundamental frameworks have since been developed and used by managers to address intra/inter-organisational connectedness including GSCF (The Global Supply Chain Forum) and SCOR (Supply-Chain Operations Reference) (Lambert et al., 2005). While different in their scope of application, they both pursue similar objectives in terms of key business processes (Lambert et al., 2005). The former refers to “the integration of key business processes from end-user through supplies that provides products, services, and information that add value for customers and stakeholders” (Lambert et al., 1998, p.1). And the latter is endorsed by Supply Chain Council (SCC) as a tool to enhance efficiency in operational process. Drawing on these frameworks, business processes are an indispensable element of cross-functional collaboration and interaction, which could support an integrated SCM (Stewart, 1997). Figure 2.2, originally proposed by Cooper et al. (1997) and later adapted by Croxton et al. (2001), depicts the connection between integration and key business processes across the SC.

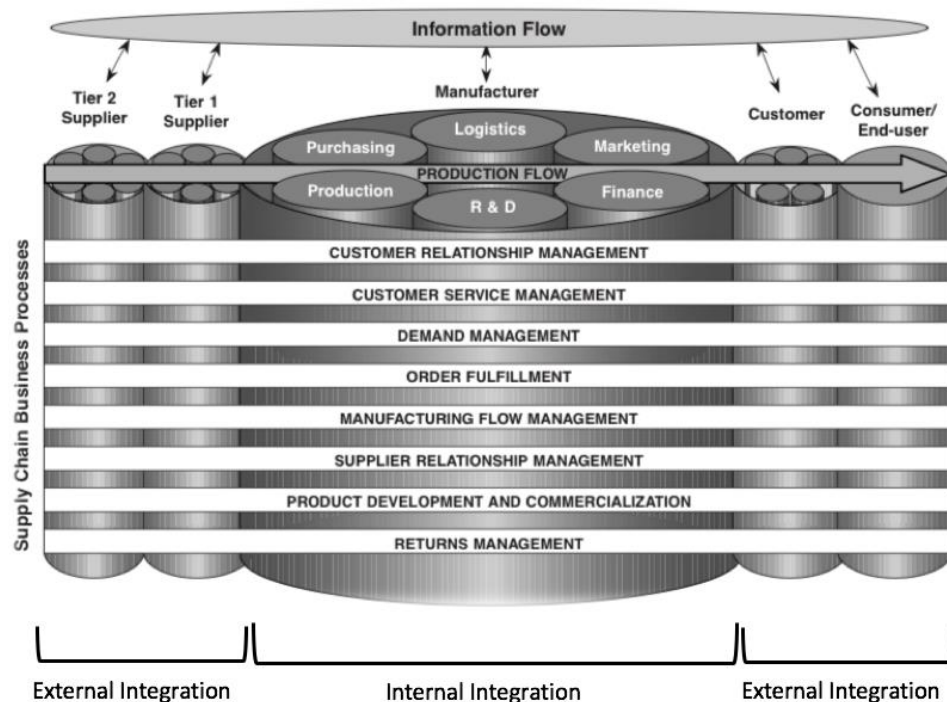


Figure 2.2. The Key Business Processes Spanning across an Extended Supply Chain adapted from Croxton et al. (2001)

Within the context of SCM, business processes are increasingly perceived as a means of structuring and integrating the operations and activities of corporate functions within and across an organisation (Day, 1997, Hammer, 2001, Lambert et al., 2005). This view point has been supported by a number of past scholars, who argue that integration should be developed between the key business functions who are in the most frequent contact with customers and suppliers (e.g. Vallet-Bellmunt and Rivera-Torres, 2013). For example, Lamb et al. (2004) argue that an extended SC is formed of both internal and external operations involved in the implementation of business processes which are influenced by their level of involvement. With this in mind, companies working together could have their internal processes linked with other firms internal processes spanning across the SC (Lambert and Cooper, 2000). Rosenzweig et al. (2003)'s model of internal and external SCI, see Figure 2.3, explicitly embodies this notion that II is part of an interdependent integration process, i.e. SCI. This model emphasises on three major entities of an organisation i.e. 'source, make, and deliver' of products, indicating that II is developed across those business functions which involve these three practices. In a similar vein, Boehme et al. (2003) visualise an extensive integrated SC where three major elements of SCI are recognised, with boundary spanning interfaces between key internal functions, e.g. sourcing, operations, product development, and logistics, and external integration with suppliers and customers, see Figure 2.4.

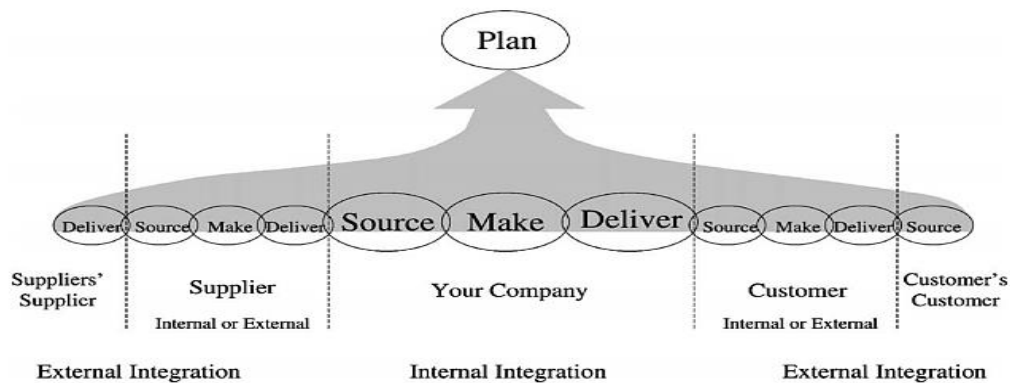


Figure 2.3. Internal and External Supply Chain Integration adopted from Rosenzweig et al. (2003)

Figure 2.4 demonstrates the extension of integration from a focal organisation into forming upstream and downstream SC collaborative relationships. This represents a common holistic approach to a supply chain originally supported by GSCF and SCOR frameworks and recognised by early scholars as well as some recent researchers (Stevens, 1989, Bowersox et al., 2002, Fawcett and Magnan, 2002, Christopher, 2016). For example, Stevens (1989, p.6) argues that “although a detailed top down approach to developing an integrated [SC] strategy is essential, its successful achievement is likely to be bottom up, evolving through a number

of stages”. Thereby, he conceptually proposes that integration model consists of four stages which begin from a so called baseline level, maturing to internal and ultimately external integration to attain an extended SCI. He argues that manufacturing organisations require to administer streamlined value adding processes to help facilitate the flow of materials from upstream to downstream. In addition, to be effective, SC also needs to get involved in the flow of information.

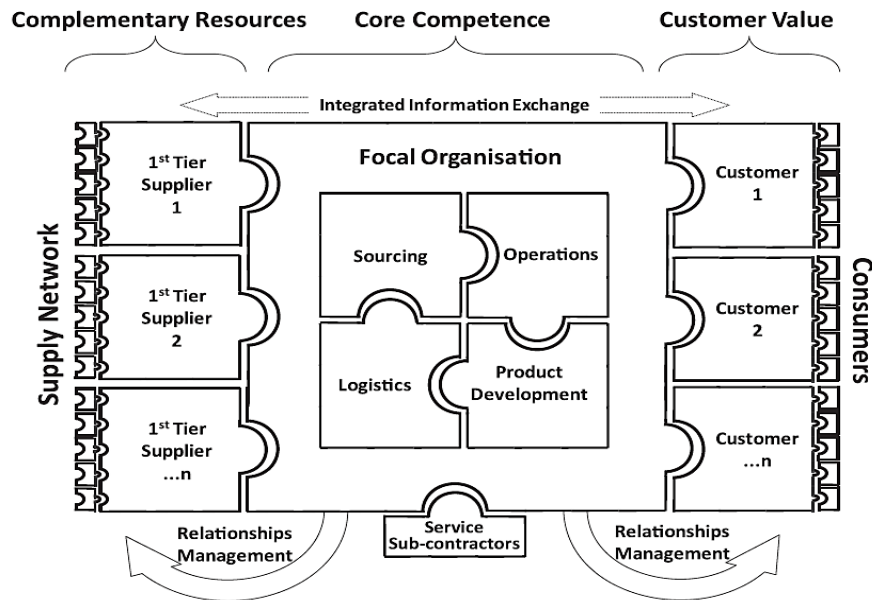


Figure 2.4. Integrated Supply Chain adopted from Childerhouse and Towill (2011)

To mature to an extended SCI business functions require connectivity reflected in the processes they get involved in (Lambert et al., 1996, Lockamy III and McCormack, 2004, Lambert et al., 2005). Without this connectivity element companies could face operational, transactional, and relational problems across functional units. When this connectivity exists within a firm, business functions could also be actively involved in the inter-firm relationships (Lambert et al., 2005). Thus, a successful inter-firm connectedness is subject to an effective II which helps to manage companies’ resources in such way that support customer needs. For this intra-firm integration to be substantiated a high level of management commitment (Lambert et al., 2005) as well as employees’ involvement are required in order to manage business processes and activities (Pradabwong et al., 2015). This significant relationship has been drawn on by various past scholars who believe that business success lies in a thorough understanding of ways to bridge the gap between intra and inter-firm supply chain members (Rosenzweig, 2009, Hsu et al., 2009). It is, though, crucial to consider that there is no trade-off between business functions and business processes within a SC. As such, their distinction must be well-recognised as it is the business functions that constitute the ground for business

processes and give rise to activities, functional knowledge and expertise (Womack and Jones, 1994).

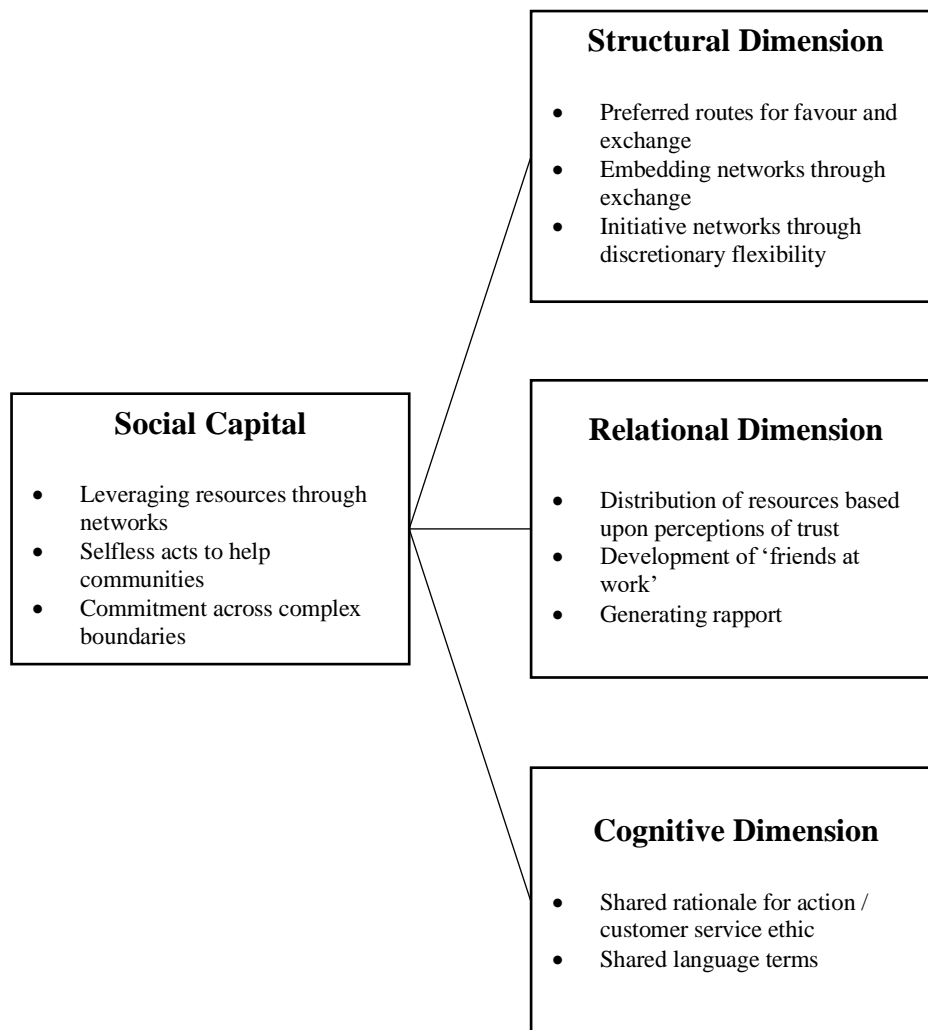
Based on the above review, this research acknowledges that when it comes to integration the matter of managing business processes and the structure of activities embedded in them becomes vital. However, empirical research provided evidence that in practice breaking down functional silos to keep the business processes flowing across functions has always exerted significant challenges to organisations (Msimangira, 2014). This is argued to have stem from functional managers/executives false perception of cross-functional team who believe that it could negatively affect their power (Simsarian Webber, 2002, Lambert et al., 2005). This raises the need for an examination of practices supporting the management of business processes in the context of II which could constitute an initial step towards overcoming the existing theoretical and empirical limitations. Further, the ground for a new stream of research could be then provided in the SCI context. Therefore, a better understanding on the link between a process approach and II needs to be identified, so the significance of human-related attributes in a process view is examined in the following section.

#### **2.4.The Manifestation of the Human/Social Aspect in a Process-Oriented Approach**

Recognised predominantly as a customer-centric approach, a process view “starts by looking further than the organisational boundaries” (Willaert et al., 2007, p.6). Customer requirements is a driving force behind this approach navigating inter-functional operations and activities which are connected through both transactional and non-transactional relationships (Willaert et al., 2007). These processes are social constructs and entail active interaction and collaboration of a series of actors/members/teams forming a social network to maximise performance (Ould, 1996, Melão and Pidd, 2000). Thus, human involvement is one of the key factors for these processes to be enacted (Weske, 2007). This approach has been extensively supported by several past researchers (Bowers et al., 1995, Antonucci, 1997, Stohr and Zhao, 2001) who put great emphasis on human issues as one of the main causes of failure in process management systems. For example, in a study by Balzarova et al. (2004) managing resistance to changes is identified as a triumph of a process management implementation. It is also argued that although, processes contain rational and technical, or in other words more static elements, their overemphasis is counter to dynamic behaviours (inherent to the human/social aspect of a business) which is subject to change due to dynamic features of a business (e.g. resource competition, uncertainty) (Melão and Pidd, 2000). Therefore, human element clearly forms the basis of a “process-oriented organisation in which people are

identified, evaluated and rewarded based on their competences in understanding and improving processes” (Willaert et al., 2007, p.10).

Process orientation has been studied as a beneficial management practices for managing social capital issues. Poor social capital is often attributed to the lack of an effective social capital management system (Zarei et al., 2014). In their case research into the concept of social capital Llewellyn and Armistead (2000) investigated the function of social capital in delivery processes of a large telecommunication company and argued that the combined effect of structural, relational and cognitive capital creates social credits shared across operational boundaries. Their findings further uncovered the implications of social capital at the process level, suggesting that each aspect of social capital acts as a distinct mechanism dealing with different facets of process complexity and operational areas, see Figure 2.5. Kujansivu and Lönnqvist (2008) also argued that process approach is a management platform that covers some intellectual capital problems. Their case study into the role of business process management in intellectual capital management demonstrated that process approach provides the means to manage intellectual capital which represents the intangible aspects of a business. Through drawing a distinction between strategic and operational level of an organisation, they further argue that while process approach “serves the development of [intellectual capital] at operational level”, it does seem to yield significant benefit at strategic level. For example, process management can help to develop intellectual capital through capitalising on employees’ competence and attitude which may lead to an improved process performance. The association between process orientation and social capital was also investigated in an empirical study by Zarei et al. (2014) who found that the adoption of a process approach could be used as a mechanism to reinforce the social aspects of a business related to structural and relational dimensions.



*Figure 2.5. The function of social capital dimensions associated with different operational areas adapted from Llewellyn and Armistead (2000)*

#### **2.4.1. The Rationale behind a Process Approach to Managing Communication and Interaction**

The challenge that is facing some organisations is associated with the way they view inter-functional relationships as being transactional. Notably, transaction-based relationships could hamper the effectiveness of inter-departmental interactions if it is not leveraged in a proper manner. Particularly, these relationships may land on the sole purpose of departmental advantage, leading eventually to sub-optimisation. As such, inter-functional relationships could become problematic and turn into a disruption in the lack of a management system guiding its activities (Willaert et al., 2007). In addition, an effective II requires understanding the criticality and nature of communication and the type of information processing requirements needed across functions (Kahn, 1996, Sherman, 2004). Therefore, a

management system which is compatible to govern human-related attributes, i.e. behavioural and attitudinal aspects, is a necessity (Willaert et al., 2007).

Research has long called for the significance of a rational decision making for coordination and integration of various functional activities and capabilities (Jassawalla and Sashittal, 1999, Swink and Schoenherr, 2015). For example, as part of their seminal meta-analysis Troy et al. (2008) investigated the type of information, e.g. customers, market, and technologies, shared between functions, and suggested that the relevance of information is crucial for effective II. They also contend that cross-functional interaction is not adequate per se if key and relevant customer information is not communicated. Furthermore, despite its benefit, too much interaction exerts excessive stress and high workloads due to the amount of inter-departmental meetings, information overload, and documentation responsibilities (Karlsson and Ahlström, 1996, Troy et al., 2008). Drawing on different levels of uncertainty in product development processes, Sherman (2004) also highlights the need for adopting an appropriate mode of cross-functional integration in different situations. This is implied to be in favour of a firm's financial resources not to invest in an inappropriate mode of integration before evaluating the type of communication required for value-added activities. This underscores the implication of the right social context in which communication is formed among human actors.

Literature has broadly accepted that in situations with high cross-functional interdependencies, integration becomes significantly important (Ruekert and Walker Jr, 1987, De Dreu, 2007, Ernst et al., 2010). Each function involves in a series of interdependent activities which it has reasonable impact on, and any disruption in its activities could potentially influence and hamper the effectiveness of other functions along the chain (Stevens, 1989). Within this social network of human actors, the focal interest is to set a stage for task-oriented and constructive data exchange achieved through gaining a mutual understanding of cooperative interdependence (De Dreu, 2007). Indeed, a clear perception of cooperative interdependence should be in place in order to maximise team effectiveness in information processing. This will allow to minimise the effect of individuals cognitive limitations, enhance tasks visibility, thereby reducing duplications of efforts and “enabling better decision making” (Swink and Schoenherr, 2015, p.69). By and large, it could be argued that both connectivity and dependency inherent in business processes as well as the significance of constructive information exchange pose the need for developing an integrative foundation as an infrastructural support for value adding processes (Swink and Schoenherr, 2015). This is enabled through the adoption of a management system providing a process-oriented approach through developing certain principles and techniques on a company-wide basis (Aparecida da Silva et al., 2012).

## **2.5.Process Paradigm: Business Process Orientation (BPO)**

In the late 1980's, the idea of managing firms operations as business process was first proposed by Michael Porter (Lambert, 2008). It was then empirically interrogated by Davenport and Short (1990), Hammer (1996) and Hammer and Stanton (1999) (Škrinjar et al., 2010), and immediately after the publication of Hammer and Champy (1993) and Davenport (1993)'s books, it became very well-known. Many researchers have since endorsed the concept of process orientation in businesses as a significant management technique, and recognised it as an indispensable component of a business process (McAdam and McCormack, 2001), due to its multifaceted managerial benefits, such as the management of inter-functional relationships, people, norms, culture, values, beliefs, etc. (Deming, 1990, Spanyi, 2003, Cardoso, 2004, Porter, 2008, Schein, 2010).

Today's global economy is moving towards establishing superiority based upon "complex bundles of skills and accumulated knowledge, exercised through organisational processes" (Day, 1994, p.38). This new approach to business provoked firms to treat "processes as strategic assets" which needs investment as they develop and mature. The evolving importance of business process maturity demands ongoing development and investment, and this leads organisations to view their business "as a combination of highly integrated processes" rather than traditional functional silos (McCormack et al., 2009, p.793). As a consequence, over the past 15 years, firms' approach has considerably shifted from a functional-oriented organisation to a 'cross-functional business process', and it triggered 'organisational culture' transformation (Braunscheidel et al., 2010).

### **2.5.1. Process View: An Emerging Approach within the Business and Management Literature**

Investigating ways to effectively respond to an increasing competition, rapid decision-making, dynamic customer orders, and the need to transform information into valuable data is a continuing concern for firms (Reijers, 2006, Seethamraju and Marjanovic, 2009, Aparecida da Silva et al., 2012). These challenges have forced companies to think of techniques to increase transparency within their business processes through shifting from the traditional hierarchical and functional management to a process-oriented management approach (Seethamraju and Marjanovic, 2009). In this sense, over the past decade, a large number of studies have attempted to shed more light on the potential benefits of a process paradigm for firms internal and external operations (e.g. Lockamy III and McCormack, 2004, Bose, 2006, Reijers, 2006, Frye and Gullledge, 2007, Škrinjar et al., 2008, Škrinjar and Trkman, 2013, Šebjan et al., 2014). For example, Movahedi et al. (2016) demonstrated the implications of process paradigm for both financial and operational performance, and



suggested that firms pursuing these benefits must look beyond a mere functional-oriented management. That is, they need to embrace BPO as a new approach to provide a clear focus on their value adding activities.

The significance of process orientation in various aspects of an organisation has been echoed in various studies (Vera and Kuntz, 2007, Škrinjar et al., 2008, McCormack et al., 2009, Vos et al., 2009, Kumar et al., 2010, Škrinjar and Trkman, 2013). Within the OM literature, a focus on the association between a process approach and IT has been extensively examined (Oliva and Watson, 2011). A number of researchers suggested that there is a close association between process approach and SCM (Trkman et al., 2007) and some recent publications have also come to reinforce this approach as a SCI mechanism (e.g. Lambert et al., 2005, Pradabwong et al., 2015, Pradabwong et al., 2017). In their preliminary case study research, Pradabwong et al. (2015) identified a positive association between a business process management (BPM) and a firm's level of supply chain collaboration (SCC) and further, argued that this positive relationship can help improve internal capabilities. In an attempt to define standard business processes across the SC Lambert (2008) draws on the importance of activities structure in achieving superior performance and competitiveness and indicates that managers seeking to achieve SCI leverage business processes as the means to structure their SC activities. Therefore, he suggests that to reap the full benefits of SCM implementation "supply chain process integration and reengineering initiatives should be aimed at boosting total process efficiency and effectiveness across the members of the supply chain" (p, 22). The importance of process view has been highlighted within the context of logistics (Schmidberger et al., 2009) and inventory management (Chikán, 2009) in which it is viewed as one of the key and new perspective in managing operations in these areas. In addition, a recent empirical research by Miri-Lavassani and Movahedi (2018) revealed the role of process orientation in different supply chain process areas (i.e. make, plan, source, deliver). They demonstrated that a higher level of process approach leads to certain performance objectives in each area.

Furthermore, empirical and theoretical research has provided evidence that SC integration and collaboration are becoming increasingly process-oriented (Hammer, 2001, Aparecida da Silva et al., 2012). Markedly, many leading SC parties (e.g. Wal-Mart and Dell) have focused on 'process thinking' to a large extent in order to boost their SC performance (Beth et al., 2003). Despite these significant attentions to the benefits and implications of a process perspective in the domain of SCM and OM, research still lacks insight into the practice of a process-oriented approach to achieve intra-firm integration. Therefore, this research aims to elaborate on the impact of a process approach on II and develop an understanding of the underlying factors that guide this relationship

### **2.5.2. BPO: Scopes and Definition**

Process view is the central element of business process management (BPM) which has been around for more than 20 years and is broadly perceived as the management approach aiming to analyse and improve business processes. Apart from the significant benefits reported from the implementation of BPM in the literature, such as increased process transparency, effective interaction and communication among employees, process standardisation (Jeston and Nelis, 2014), it has been viewed to follow two important goals as improving both transactional efficiency and managing relationship across the members of the SC (Lambert, 2008). While the transactional view focuses on advancing communication and information technology, relationship view seeks to manage SC relationships in order to efficiently fulfil customers order.

Process thinking refers to a cross-functional and customer-oriented approach and provides a result-oriented outlook to an organisation. Given the belief that processes are the main aspect of an organisation by which it is described, process management refers to establishing mechanisms/techniques for its governance, and is considered a paramount value-adding element of an organisation (McAdam and McCormack, 2001). In this regard, “It is increasingly common to describe organisations as sets of business processes that can be analysed and improved by approaches such as business process modelling” (Melão and Pidd, 2000, p.1). Thereby, BPO has been proposed as a strategy to highly integrate processes, allowing firms to depart from viewing their businesses as an aggregate of distinct functions and treat their processes as strategically important (McAdam and McCormack, 2001).

The definition of process orientation has been comprehended differently in the literature. Reijers (2006) defines it as shifting the focus from hierarchical and functional structure to business processes for the purpose of improving the entire value chain operations. Based on their extensive literature review, McAdam and McCormack (2001) revealed the most comprehensive BPO definition as the level of an organisation’s emphasis on its core processes which require an end to-end approach, within the scope of the organisation. At the heart of BPO is to focus on value adding activities (Lindfors, 2001). Recognised as a horizontal organisation approach (Ostroff, 1999), it is concerned with a firm’s effort in making the use of key processes to provide a “platform for organisational structure and strategy planning” (Kohlbacher and Gruenwald, 2011a, p.267). This management approach “can bridge the gap between strategic and operational levels of [an] organisation” (Näslund and Karlsson, 2004, p.71), while also enables a company to identify sources of problems easily and effectively, and accelerates the resolution procedure (Trkman et al., 2007). BPO actively stimulates a ‘matrix-like structure’ promoting the recognition of functional entities and adopts an overarching approach pinpointing each function’s extended responsibilities and

contribution to business processes. It also enables a firm to identify its main stakeholders (Draheim, 2010).

### **2.5.3. BPO Elements**

McCormack et al. (2009, p.795) point out that BPO comprises three basic elements of ‘process jobs’, ‘process view’, and ‘process management and measurement’. ‘Process job’ is indicated as one of its key elements and refers to “jobs that focus on processes as opposed to functions, and are cross-functional in responsibility” (Lockamy III and McCormack, 2004, p.273), for example product development process (Willaert et al., 2007). The main emphasis in process job is on ‘process ownership’ and ‘process teamwork’ (Tang et al., 2013). ‘Process view’ is defined by McAdam and McCormack (2001) as the level of understanding of a business process from input to the output within a firm and the degree of its documentation. Tang et al. (2013) also add that ‘process view’ is “the cross-sectional, horizontal picture of a business involving elements of structure, focus, measurement, ownership and customers” (McAdam and McCormack, 2001, p.187, Lockamy III and McCormack, 2004, p.273). The third element, ‘process management and measurement’ is concerned with the evaluation of processes efficiency and effectiveness in terms of quality, cost, cycle time and variability (Tang et al., 2013, Trkman et al., 2007). In order to evaluate these aspects, an extensive process documentation should be employed for process management and measurement (Willaert et al., 2007).

Additionally, BPO involves two supporting elements, including ‘process structure’ and ‘customer-focused process values, and beliefs’ (Lockamy III and McCormack, 2004). The former emphasises the horizontal organisational structure, shared ownership and partnerships across business functions. And, the latter refers to organisation’s culture and beliefs prevailed among its members with regards to, for instance, trust and continuous process improvement. Literature review revealed that past studies have drawn on relatively different breakdowns of the dimensions. Some only incorporated the three basic elements (McAdam and McCormack, 2001, Škrinjar and Trkman, 2013) while others expanded their conceptual model to include a larger set of elements (Reijers, 2006, Kohlbacher and Gruenwald, 2011a, Movahedi et al., 2016). Nevertheless, the five aforementioned dimensions originally developed by McCormack (1999) have been examined extensively by previous researchers (e.g. Davenport, 1993, Reijers, 2006) and formulate the underlying theoretical basis of a process-oriented approach (Lockamy III and McCormack, 2004).

#### 2.5.4. BPO Developmental Stages

In an attempt to execute an extensive BPO, an organisation needs to depart from a functional structure to cross-functional interaction and communication, leading to the notion of process maturity. Process maturity emanated from the perception that processes involve some forms of developmental stages, and is an indication of “the broad adoption of BPO”. During their life cycle processes need to be “clearly defined, managed, measured and controlled” as they mature (McCormack et al., 2009, p.793). At this mature level, processes are highly integrated, jobs are process-centred and a cross-functional business environment is established (Lockamy III and McCormack, 2004). In companies with a broad adoption of BPO, cross-functional culture is dominated and the key processes are customer-oriented (McAdam and McCormack, 2001). The maturity model<sup>2</sup> also adopted in different contexts, such as organisational performance, SCM, SCI, marketing, logistics, IT, etc. (Kwak and Ibbs, 2002, Narayandas and Rangan, 2004, e.g. Trkman et al., 2007, Škrinjar et al., 2008, Trkman, 2010, Wang et al., 2016), recognises that process capability is advanced as processes achieve a new maturity level along the maturity continuum (McCormack et al., 2009). Lockamy III and McCormack, (2004) propose a maturity model (see Figure 2.6) comprising four stages upon the completion of which process maturity could be attained:

- I. Ad Hoc:** At this level processes are at their early stage of their maturity and unstructured. Process measures are not well defined, nor specified, and traditional functional silos is prevailed as the organisation’s structure.
- II. Defined:** At this level the definition of basic processes is specified and documented, and process transformation needs to be considered. The transformation process happens through a series of established actions conducted in order to change processes. The structure of the organisation and jobs is still functional. In addition, within this traditional functional context, business functions delegates hold regular meeting and collaborate together.
- III. Linked:** At this level, firms start to depart from traditional functional context for a more process-oriented structure. Process structure and process jobs are established, and “managers employ process management with strategic intent and results” (McCormack et al., 2009, p.794).
- IV. Integrated:** At this stage, inter/intra-organisational cooperation happens at the process level. All three basic BPO components are deeply in place in the

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<sup>2</sup> A wide ranges of maturity model exists (see Röglinger et al., (2012)), yet this research only refers to BPO maturity model which has been widely used in SCM and OM fields.

organisation, “and traditional functions begin to be equal or sometimes subordinate to process” (McCormack et al., 2009, p.794).

- V. Extended:** This level represents the stage at which responsibility and ownership are developed across an extended supply chain where key processes are based in. “Trust, mutual dependency and esprit de corps are the glue holding [this] extended supply chain together. A horizontal, customer-focused, collaborative culture is firmly in place. Process performance and reliability of the extended system are measured and joint investments in improving the system are shared, as are the returns” (Lockamy III and McCormack, 2004, p.276).

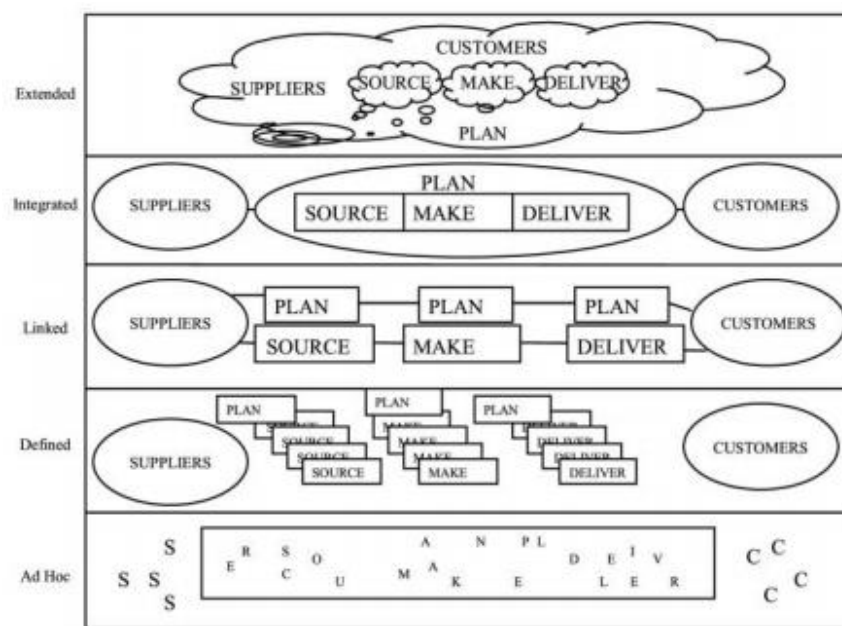


Figure 2.6. The SCM maturity model adopted from Lockamy III and McCormack (2004, p.276)

Figure 2.7 adopted from Lockamy III and McCormack (2004) illustrates the relationship between BPO and process maturity. Moving from one stage to a higher stage towards process maturity institutes process know-how and competencies in a firm (McCormack et al., 2009). To successfully achieve the maturity level an organisation needs to create and sustain a culture and an infrastructure which reinforce process-oriented approach (McAdam and McCormack, 2001, Lockamy III and McCormack, 2004). Once this maturity is established the institutionalisation of a ‘system perspective’ is facilitated which could then help an organisation to shift from internally focused perspective to encompass external elements of the business (Paulk, 1993, Ladeira et al., 2016). With this system perspective, the process paradigm treats a corporation “as a system of integrated and interrelated processes” (Lindfors, 2001, p.3) and renders a structural process transformation across the border of an organisation.

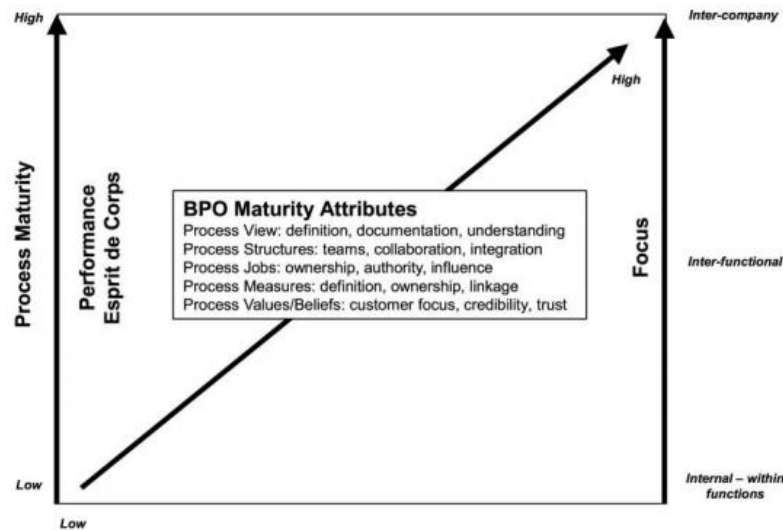


Figure 2.7. Relationship between BPO and process maturity adopted from Lockamy III and McCormack (2004, p.274)

### 2.5.5. Process Maturity and the Key Turning Points (KTPs)

KTPs represent the route from ‘ad hoc’ to ‘integrated’ level in process maturity model, and can be applied to lead an organisation to systematically organise and prioritise the tasks to achieve certain levels of BPO (McCormack et al., 2009). Growing to a higher level of maturity will lead to a more structured approach to BPO. For this transition to take place, it is imperative for an organisation to identify the KTPs to move to the next level across the maturity continuum. It is argued that, grounded on the developmental stages of BPO certain elements take precedence and are first established at each maturity level (McCormack et al., 2009). Once stabilised, these elements could then provide the basis for other component to be emphasised. In an attempt to understand the transition between BPO stages, a few past studies have identified the KTPs in maturity model, using various techniques, such as data mining and decision trees (McCormack et al., 2009, Vlahovic et al., 2010, Glavan, 2014, Glavan et al., 2015). McCormack et al. (2009)’s exploratory research was amongst the very first studies in which they explicitly discussed the need to identify the KTPs and classify organisations into different maturity levels. Using data mining techniques, Glavan et al. (2015) suggested that to advance from ad hoc to defined level firms need to start by defining roles and responsibilities, process measures, and target values followed by promoting process culture, suppliers cooperation and the development of process-oriented IT. They further identified that the transition to the next maturity level requires a thorough process examination and documentation without which firms may fail to identify their value-adding processes. In addition, Vlahovic et al. (2010) emphasised on the management support as the first turning point, suggesting that it lies in the management commitment to implement process re-design.

They further discussed that this should be followed by defining and documenting processes, defining roles and responsibilities, and advanced to process management & measurement at an integrated level.

Within this body of knowledge it has been shown consistently that at an aggregate level process job, process management & measurement, and process view which were originally identified by McCormack et al. (2009) are amongst the most important factors making the move through BPO maturity path. 'Process jobs' is suggested to be the foremost and leading factor at the 'defined' level of process maturity model with 'process management and measurement' succeeding. According to McCormack et al. (2009, p.795), these two turning points at the early stages of maturity continuum would "stabilise within an organisation and lead to the establishment and expansion of [process view] that move the organisation to the next maturity level". Furthermore, the presence of the two supporting elements of BPO is of great importance to provide the structure and culture for the development of the three basic elements operating interactively (McCormack et al., 2009, Vlahovic et al., 2010).

#### **2.5.6. Process Orientation and the Value Chain**

It is the essence of most companies to involve in a series of practices encompassing design to production, and delivery to customer services (after sale services). "A firm's value chain and the way it performs individual activities are a reflection of its history, its strategy, its approach to implementing its strategy, and the underlying economics of the activities themselves" (Porter et al., 1985, p.36). Process-oriented approach places paramount emphasis on value-adding processes (Lindfors, 2001, Movahedi et al., 2016) where value is embedded and what customers essentially want (McCormack and Rauseo, 2005). As for the great importance of establishing efficient and effective value chain, a process-oriented approach is considered as an enabler and crucial, fostering a cooperative working environment which will support people in their collaborative work and grow connectedness between departments (McCormack, 1999, Trkman et al., 2007).

It is emphasised that value-adding activities are not autonomous activities, but they are linked, and the way one activity is carried out will affect the performance of one another. Managing these linkages between activities requires the collaboration and coordination beyond traditional boundaries between business functions (McCormack and Johnson, 2001a). Aimed at improving process linkages, process management enables to identify, manage and maximise the connectivity between value-adding processes. This renders the opportunity to create consistency between the ways processes are coordinated, thus maximising internal coordination (McCormack and Johnson, 2001a, Lambert, 2008). In a similar vein and with

regards to logistical processes, Robertson et al. (2002, p. 4030) argue that “these linkages provide the actualisation of true integration”. Indeed, “it is via these linkages that the synchronisation and coordination of [...] process are achieved in practice” (p. 4031).

To avoid the possible confusion it is deemed necessary to briefly discern the concept of value chain and SC by drawing on what Monczka et al. (2015) explain. SC can be described “as the subset of the value chain” (p.14). At an organisational level, the concept of value chain is broad and includes all the activities, either primary or supportive, performed for order fulfilment. As opposed to the supply chain which focuses both on internal and external parties, value chain predominant focus is internal. This research referred to the concept of value chain within the context of BPO to solely emphasise the importance of connectivity between key functional departments, i.e. R&D, manufacturing, logistics, etc. which increases the transparency and visibility of key business processes. It also determines the associations across functions, addressing the focus of this research.

## **2.6. Product Architecture and Supply Chain Management (SCM)**

To compete in today’s heterogeneous markets, firms need to simultaneously involve in decision making in three key areas of process, product and supply chain. These decisions cover both strategic and operational aspects of a business and involve the design of processes and their operations across the three domains. They also enable the movement of product throughout the value chain and, as such could be influenced by a product characteristics (Fixson, 2005). MacDuffie (2013) particularly argues that decisions about product and process domains are deeply intertwined in a way that changes in one area has an impact on the structure of the other. Decisions at the product level are crucial in a sense that they involve both long term and rather short term horizons. Long term decisions embrace acquiring and maintaining specific capabilities in the form of skills, knowledge, etc. in order to gain defined competencies, selecting facilities location, and developing strategic alliances. Shorter term decisions, however, encompass the issues which have influence at project and organisational level, such as product functionality, materials choices, the structure of development team (i.e. whether cross-functional or based on functional specialisations), sequence of operations and their interdependencies, and the degree of overlap between activities. Within this product domain, one element that plays a critical role in designing strategic and operational strategy is product architecture (Fixson, 2005).

According to Ulrich (1995, p.419) product architecture is generally defined as “the scheme by which the function of a product is allocated to physical components”. In particular, it characterises the fundamental structure of a product, encompassing the information on a series of product specifications such as the quantity of parts and the number of their interfaces,



the type of their functionality and the way they are related and work together (Fixson et al., 2005). In other words, it translates “functional requirements into physical definitions of building blocks” (Zwerink et al., 2007, p.49). Decisions about product architecture are extensive and influence the entire product life-cycle, ranging from conception to production to product retirement (Ulrich, 1995). In support of this, Zwerink et al. (2007) note that product architecture has implications beyond the immediate product development stage at which decisions about different aspects of the product design are made. They further add that decision effects of product architecture have consequences for the value chain which arise in later stages of the development process. Therefore, not only it shapes a business strategic decisions, product architecture has a bearing on operational decisions concerning multiple functions such as marketing, purchasing, manufacturing, etc. (Laseter and Ramdas, 2002, Mikkola, 2003). Anchored within these arguments, this research seeks to investigate the implication of product architecture for internal integration (II).

Product architecture is increasingly recognised to determine the structure of product development process. In reference to this, research within the context of SCM has long come to terms with the implications of product architecture for supply chain design (Nepal et al., 2012). Prominently, a number of researchers argue that decisions about supply chain configurations, and manufacturing processes are significantly affected by product architecture (Fisher, 1997, Fine, 1998, Huang et al., 2005, Graves and Willems, 2005). For example, it is argued that supply chain dynamics are influenced by variations in product structure (Verdouw et al., 2010). Child et al. (1991) reported that product and process design accounts for 50% of business complexities. Results from Pero et al. (2010)’s case study demonstrated that supply chain performance is dependent on the degree to which decisions around product design and supply chain are adapted. Similarly, Fixson (2005) operationalises the concept of product architecture to develop a multi-dimensional assessment framework and suggests that individual characteristics of product architecture enable operational decisions within the domain of supply chain by influencing resource planning, service levels, delivery schedules, etc.

### **2.6.1. The Implications of Product Architecture for Inter-Firm Relationships**

The concept of product architecture has been discussed in the supply chain management (SCM) literature for a long time (Lau et al., 2010a). Although, several studies have attempted to explore the relevance of product design for SCM (Fine, 1998, Ulrich and Ellison, 1999, Salvador et al., 2002, Sako, 2003, Voordijk et al., 2006, Doran et al., 2007), their discussions have mainly remained conceptual. In light of such interests in identifying the implications of product architecture for the supply chains, a few studies investigated the impact of product modularity (PM) on supply chain integration (SCI) (Howard and Squire,

2007, Ahmad et al., 2010, Lau et al., 2010a). However, concerns have arisen which question the validity of their observations since controversial views were presented. In this regard, it is argued that research in this context is still at its early stages (Lau et al., 2010b).

Research draws a distinction between two theoretical positions on the consequences of product architecture (Cabigiosu and Camuffo, 2012). In one hand, some advocate the idea of loosely coupled supply chain relationships as a consequence of embedded coordination in a modular product architecture (Sanchez and Mahoney, 1996, Sosa et al., 2004, Baldwin, 2007). On the other hand, some studies maintain that product modularity (PM) leads to ‘thick’ inter-firm relationships (Hsuan, 1999) and promotes more collaboration. The first body of research argues that the need for excessive coordination and knowledge sharing is reduced due to the information encapsulated within modules. As such, inter-firm interdependence is lowered. Taking an opposite perspective, the second theoretical position perceives modular architecture as an enabler for building suppliers collaborative relationships (Hoetker, 2006). In fact, it is believed that modularisation becomes possible only if a firm’s knowledge of product design outweighs that of their suppliers and only when it involves in more collaboration with its module suppliers (Brusoni and Prencipe, 2001). In this sense, not only the tendency to maintain inter-firm interdependence remains ubiquitous, it continues emerging as their relationship is further developed (Staudenmayer et al., 2005).

The basis underlying these conflicting views is largely grounded on whether the concept of the ‘mirroring hypothesis’ holds true (Cabigiosu and Camuffo, 2012). “The mirroring hypothesis predicts that organisational ties within a project, firm, or group of firms (e.g. communication, collocation, employment) will correspond to the technical dependencies in the work being performed” (Colfer and Baldwin, 2016, p.709). The relevant literature that pertains to the mirroring hypothesis, by and large, makes the use of the concept of modularity to explain its fundamental principle. Empirical research provides evidence that at industry and firm level this prediction appears to be a prevalent pattern but is not always the case (Colfer and Baldwin, 2016). It is also evident that while this theoretical view is dominantly held among scholars, there has been some empirical evidence against the mirroring of technical dependencies and organisational ties, suggesting a positive association between product modularity (PM) and supply chain networks. For example, Jacobs et al. (2007) reported that modular design results in the ease of three forms of integration, namely design, supplier and manufacturing, through which communication and information sharing are facilitated, improving trust among supply chain members. Lau et al. (2010b) further conducted a multiple case research and studied the dynamics of PM and SCM. Their empirical results suggested that the positive and negative effect of PM on supply chain integration (SCI) is contingent on multiple factors. These factors, which showed to have distinct consequences for internal and

external ingeration, include “new module/component development, technological knowledge leakage and capture, project team size and supply chain efficiency” (p.965).

### **2.6.2. Modularity: Scopes and Definition**

Modularity is identified as an architectural property that could be used in the design of products, organisations and inter-firm relationships (MacDuffie, 2013). Despite its architectural effects, modularity may be pursued both as a process or a cognitive frame. Modularisation as a process is a learning procedure which shapes the scope of a firm’s activities and is utilised to help managers understand the product and organisational architecture, modular boundaries, modules interdependencies and their interfaces. While, modularity as a cognitive frame provides the means for interpreting and regulating the inter-relationship between modularity as a design property and modularisation as a process (MacDuffie, 2013). As a design property, companies adopt both product and process modularity (Colfer, 2007) to address challenges ranging from technology change, product development cycle time, distribution, mass customisation, etc. (Vickery et al., 2016). Recognised as a strategy, modularisation is used to improve process efficiency and manage products complexity (Baldwin and Clark, 2003b) “by decomposing complex task into simpler portions so they can be managed independently and yet operate together as a whole” (Mikkola, 2005, p.497). As such, managing complexity is the core driving force for modular product designs (Ethiraj and Levinthal, 2004). “On the process side of things, modularity embodies the notion of a dynamic network of relatively autonomous production modules that can easily be reconfigured to support and accelerate the launch of a new product” (Vickery et al., 2016, p.2). Although, literature on different aspects of modularity is ample, for the sake of the context this research we solely focus on modularity as a product design property and its corresponding effects for processes. In other words, the core focus of this research is on PM, yet, the discussion around process/organisation modularity is also included in order to explain the significance of modular product for process approach and internal integration (II).

PM is mainly characterised as a continuum of three key concepts of “separateness”, “specificity”, and “transferability of product components in a product system” (Antonio et al., 2009, p. 307). However, due to its multidimensionality, a number of other features and definitions have been assigned to it along its continuum, such as reusability, interchangeability, standardisation and decomposability (Sanchez and Mahoney, 1996, Duray et al., 2000, Schilling, 2000, Worren et al., 2002, Bessant et al., 2003). The degree to which a product can be deconstructed and reconstructed back into a different product while maintaining its actual functionality is defined as the level of its separateness (Schilling, 2000). “Specificity refers to the degree to which a product component has a clear, unique and definite product function within the product system” (Bask et al., 2010, p.362). And, the degree to

which a product component can be transferred to be used in a different product system is referred to as the level of its transferability (Starr, 1965).

With reference to the above definitions, literature identifies three key aspects of modularity as *functional binding*, *interface standardisation* and *decomposability*. Modular product supports the creation of *functional binding* which refers to the one-to-one mapping of functions to physical components/modules. On the basis of this '*functional binding*', the elements of a system are divided into independent units/modules while their functionalities are maintained (Schilling, 2000, Baldwin and Clark, 2000). As such, their autonomous design is enabled, reducing the modules interdependencies. This characteristic of modularity has given rise to the concept of loosely coupled module interfaces and triggered a controversy among scholars who were affiliated to different research streams as a result. It is then one of the central tenet forming the underlying basis of this research arguments. Modular product permits '*interface standardisation*' by the use of interaction mechanisms that are recognised and agreed upon as a form of coordination into the product development process. Standardised interfaces facilitate the interchange of system components without hampering the system functionality. Through providing an embedded coordination system, they also minimise the coordination efforts across modules (Sanchez and Mahoney, 1996). Therefore, modular products are developed in such a way that the interaction within the module's components is minimised while that of the between-modules tends to be high. This high interaction between the modules makes decomposition a critical aspect of these products (Jiao et al., 2007). Thus, owing to standardised interfaces, a modular architecture offers parts '*decomposability*' "which allows a system to be readily reconfigured using the same, similar, or complementary components without deleterious effects on performance" (Vickery et al., 2016, p.754).

"Modularity is a matter of degree" (Brusoni and Prencipe, 2001, p.183). Baldwin (2007) describes modular design as a structure that creates module boundaries which allow for 'thin crossing points'. Precisely, the thin crossing points formed between modules reduce the need for coordination traffic which is common in integral development organisation (McCord, 1993), but it is not fully eliminated since the nature of a product architecture is a matter of degree. This means that all products/systems have some degree of modularity, and by the same token, all systems are also integral to an extent (Schilling, 2000). Thus, full modular or integral architecture is seldom achieved (MacDuffie, 2013). Mikkola (2005) referred to this aspect of modularity and suggested that the degree of PM which lies along a continuum represents a dynamic issue in the degree of interdependence across the supply chain. He further studied the scope of product architecture impacts on the supply chain and argued that PM increases the strategic flexibility for manufacturers (Sanchez, 1995, Worren et al., 2002), and as such affects supply chain management (SCM) at both firm and inter-firms levels. Despite the broad landscape of its organisational impact, the present research aims to

only focus on the firm level effects concerned with module interdependencies and respective interfaces and their connection with communication patterns (Colfer, 2007).

### **2.6.3. Product Architecture and Organisational Design: The Effect of the Mirroring Hypothesis**

Literature has frequently studied the link between product architecture and organisational design (Sanchez and Mahoney, 1996, Sosa et al., 2004, Gokpinar et al., 2010, MacCormack et al., 2012). It is argued that it is the product architecture that determines the structure of an organisation design (Sanchez and Mahoney, 1996) and its adoption significantly alters the pattern of works arrangement and relationships. This consequently affects the impact of integration on competitive capabilities (Antonio et al., 2009). Similar to the premise underlying the conflicting theoretical positions discussed earlier, much of the literature that examines the relationship between product architecture and organisational structure posits the ‘mirroring hypothesis’ which, as briefly discussed before, is the claim that a product architecture must be echoed and has a reflection on the structure of a product development organisation (Colfer, 2007). Within this body of knowledge, the concept of product modularity has emerged as a matter of debate due to its ex ante influence on the organisational design. This literature has extensively investigated the degree of coupling between product architecture and organisation system (Langlois and Robertson, 1992, Sanchez and Mahoney, 1996, Schilling, 2000, Baldwin and Clark, 2003a, Fixson et al., 2005, Hoetker, 2006, Colfer and Baldwin, 2016) and how this relationship influences the system behaviour and performance (Ethiraj and Levinthal, 2004).

Generally speaking, “the mirroring hypothesis holds that an integral organisation is necessary for developing an integral product, while, a modular organisation is only capable of developing a modular product” (Colfer, 2007, P.6). In more specific terms, Colfer and Baldwin (2016, p.5) draw on technical knowledge in modular system and explain that “information hiding as a means of controlling complexity is a fundamental principle underlying the mirroring hypothesis. With information hiding, each module in a technical system is informationally isolated from other modules within a framework of system design rules”. This indicates that while several business units/individuals are able to operate independently at a module/unit level, the modular product functionality will be maintained at a system level (Baldwin and Clark, 2000). The logic of information hiding is viewed as a key advantage of modular architecture which lessens the need for individuals to obtain unnecessary knowledge and information. In fact it allows for the creation of work divisions shaped around individuals with bounded rationality whose main efforts centre on the tasks related to their assigned module (Colfer and Baldwin, 2016).

The origin of the mirroring hypothesis relied upon two distinct views derived by Conway (1968) and Thompson (1967). While, Conway's approach suggests that a unidirectional causation runs from organisational ties to technical dependencies, Thomson believes that the causal effect holds true in the opposite direction. Conway argued that the presence of work interdependence signifies that communication links across organisation groups preceded technical interdependencies. Indeed, designing a complex system requires cross-teams negotiation, cooperation and communication to be a point of departure to detect technical dependencies and define interface specifications. Whereas, Thomson argued that groups are clustered around those tasks which contain extensive technological interdependence. These groups are formed in a way that they create a form of hierarchy depending on the degree of actors' interdependency. In other words, those with the greatest technical interdependence are first clustered, ranked as the first-order group, and smaller groups are then formed under a less extensive interdependence and categorised as second-order group. The key aspect of this approach is that a high degree of interdependence drives the need for extensive communication mechanisms, such as collocation, common dispute-resolution mechanism, and communication linkages, in order to address technical ties.

Although, Thomson's approach appears to be a common belief among management scholars, results from Colfer and Baldwin's (2016) study revealed that, while the association between technical interdependencies and organisational ties emerged as a general pattern (stronger correlation (77%) was found in their within-firm sample compared to the across-firm and open-collaborative projects), mirroring effect involves an evolutionary process which is dynamic in nature. According to his observations on the dynamics of the mirroring hypothesis, firms operating in industries with high level of systems complexity and continuous technology changes tend to reflect a partial mirroring. In order to compete in such active and technologically dynamic business environments, they need to define their knowledge boundaries beyond their operational boundaries and strategically break the mirrors which may pose some limitations for pursuing architectural innovation. Therefore, it is suggested that partial mirroring is likely to be a superior approach in these organisations who seek to adapt to the structure of their industries changing over time (Colfer and Baldwin, 2016). Furthermore, comparing the boundary conditions on mirroring of inter and intra-firm samples, they found that those who choose to preserve architectural innovation within their firm's boundaries face more technical dynamics, and as such they tend to use a less common form of mirror-breaking. This entails pre-empting "rivals by increasing the rate of technical change necessary to compete in their product markets" (p.729).

Similar results were obtained from Cabigiosu and Camuffo (2012) study in which the mirroring hypothesis was supported at the component level (i.e. modularity as a product property). These results were subject to product architecture stability. It was demonstrated that

whether the mirroring effect holds true is contingent on a firm's alternative strategies, organisational capabilities and structure. In this sense, higher PM may be associated with increased information sharing with suppliers which indicates a complementary approach to this relation. A complementary approach implies that modular architecture and information sharing are related in a way that a rise in the level of one evokes positive behaviour in the other. In other words, high PM is associated with extensive information sharing with suppliers, and vice versa. Thus, they have synergistic effects and the use of both simultaneously increases the returns on product modularity design. Alternatively, on the basis of a trade-off approach which draws on knowledge encapsulation, this relationship is reversed, meaning that high modularity acts as a strong coordination mechanism and is a substitute of information sharing. This indicates that high PM lessens the need for high information sharing, resulting in loose buyer-supplier relationships. Furthermore, they argued that the two strategies are not mutually exclusive, so they may be adopted at the same time for different groups of products/components. Therefore, they conclude that it is important to account for product architecture stability for testing the mirroring hypothesis as its premises may have no bearing on organisational structure in terms of the degree of coupling.

Even though, an extensive range of organisational merits and flexibility (increased product variety, decoupling of development functions, etc.) has been attributed to PM, it is argued that complexity could become a determinant factor challenging the scale of these benefits for both product and the processes involved in the execution of product development tasks (Simon, 1962, Vickery et al., 2016). To explain this argument, Vickery et al. (2016) compare the notion of complexity in the production of toaster ovens and automobiles, indicating that the magnitude of complexity impact is significantly different in either of the product. For a toaster oven which has relatively simple structure, the production process involves the manufacture of less complicated interfaces compared to that of an automobile. Assuming that the same architectural principles for product designs are applied in both products, it could be expected that product complexity (characterised as high product modularity, intricate interfaces between modules, number of components/modules/units) has a far more detrimental impact on the tasked processes for the automobile development. As a result, a modular product organisation may fail to achieve its set outcomes.

#### **2.6.4. The Implications of PM for Internal Integration (II)**

Modularity and integration are commonly adopted by manufacturers as the two most important practices to achieve competitive advantage (Fine et al., 2005, Antonio et al., 2009). While, a great deal of research involves understanding the technical aspects of modularity (Salvador et al., 2002, Nobelius and Sundgren, 2002, Mikkola, 2003), the implications of PM for value-adding activities spanning several function is still at its infancy. The literature

usually associates PM with integration and studies the effect of integrative mechanisms on modular product development performance, such as supplier involvement and inter-functional collaboration (e.g. Lau et al., 2010a). For example, Howard and Squire (2007) found that PM is significantly related to collaboration with suppliers to co-develop products. Similarly, in their case analysis Lau and Yam (2005) demonstrated that product development lead time and inventory level could be minimised through modularisation coupled with close SC design and suppliers collaboration in joint product co-development. In addition, Sako (2002) draws on the implications of modular architecture for the SC and processes and argues that it is likely that product development requires an intensive integration of designers, manufacturers and customers. The central focus in these studies is generally on the use of external integrative mechanisms, for instance in the form of leveraging suppliers organisational capabilities and knowledge, for effective product development. Indeed, drawing on a resource-based view of product development, they argue that in order to improve product performance, firms need to integrate and coordinate their internal resources with that of their external suppliers (Verona, 1999).

The association between PM and integration has been the subject of many theoretical debates as to whether PM requires tightly integrated SC (e.g. Galvin and Morkel, 2001, Laseter and Ramdas, 2002, Nobelius and Sundgren, 2002, Gerwin, 2004, Lau et al., 2010a). Most of the research that focused on this debate has investigated the direct effect of integration on PM. For example, Sanchez (1999) suggested that in order to fully address the potential benefits of a modular product, multiple departments, e.g. manufacturing, marketing, engineering, and logistics, need to be integrated in design stage. In order to refine module interface specifications, Sabel and Zeitlin (2004) argue that internal functional units may need to involve in iterative co-development projects. Sosa et al. (2004) draw on the importance of technical information sharing and argue that it can significantly reduce the possibility of technical errors if effectively exercised across module teams.

While research has frequently suggested that both intra and inter-firm product co-development have positive implications for effective modular design (e.g. Brusoni and Prencipe, 2001), a modular architecture has been characterised as less dependent on internal coordination than integral products by some researchers (e.g. Fine, 1998, Baldwin and Clark, 2000). Despite this argument, it is suggested that success in modular product development process, ranging from concept definition to system-level design, is subject to close inter-functional coordination (Gerwin, 2004). In particular, products with high level of modularity need the involvement of several functions to carefully examine and specify design interfaces (Ulrich, 1995, Antonio et al., 2007). As such, the development of modular product may entail the integration of knowledge and expertise spanning several functions in order to identify products specifications and customers requirements. A recent study by Antonio et al (2009)



emphasised on the complementary effect of this relationship and proposed that internal integration (II) and PM may interact to positively affect a firm's competitive advantages. Their empirical results verified this relationship to some extent and suggested that while the interaction effect of II and PM significantly improves product quality and innovativeness, it did not lead to any competitive capabilities in terms of cost, customer service, flexibility and delivery. Based on these results they suggested that synergistic performance could not always be expected as a result of their interaction.

In addition to the operational implications of PM for product development (Pine, 1993, Sanchez and Mahoney, 1996, Fine, 1998, Baldwin and Clark, 2000, Ulrich and Eppinger, 2000), several attempts have been made to shed some light on the impact of modular product on coordination mechanisms and patterns (Fine, 1998, Schilling, 2000, Baldwin and Clark, 2000, Schilling and Steensma, 2001, Salvador et al., 2002, Sosa et al., 2004, Mikkola, 2006). In this context, theoretical literature has extensively highlighted the significance of product architecture in the value-creating activities (Morita et al., 2013) and argued that the need for extensive II may be diminished as a result of PM (Sanchez, 1999, Baldwin and Clark, 2000). In line with Parker and Anderson (2002) argument, Lau et al. (2010a) argue that "manufacturers need to decide the modularity of their products with [SC] design; otherwise they may lose their value-adding activities to the suppliers and be edged out of the business". Sanchez (1995) was among the very first scholars who noted that well-specified design interfaces could reduce the need for intensive cross-team interaction, and thus result in organisational dis-integration due to tasks decomposition. Likewise, Hoetker (2006) posited that PM reduces the need for intra-firm suppliers communication, thus creating a loosely coupled organisational forms. This allows for individuals to work in autonomous design teams who are divided on the basis of their expertise and reduces redundant and repetitive communication as the process of labour division speeds up. As such, Langlois and Robertson (1992) argued that "the development of modular systems can lead to vertical and horizontal disintegration". However, in products with less-specified and more complex design interfaces there is a great need for intensive inter-functional interactions (Sosa et al., 2004).

While these studies have attempted to theoretically highlight the possible consequences of PM for internal functions, their arguments lack empirical support (Fine et al., 2005, Howard and Squire, 2007). To address this gap, a few past researchers have conducted empirical studies and examined how PM is related to inter-functional coordination. For example, results from Danese and Romano (2004) indicated that PM improves competitive performance through influencing II. In particular, they found that PM leads to information sharing, and coordination improvement as well as design activities simplification. Ahmad et al. (2010) studied the role of PM on competitive capabilities through examining the direct effect of PM on inter-functional design coordination. Their findings demonstrated that inter-

functional coordination creates a mechanism in modular product development in order to meet information processing needs and cope with increased uncertainty. In turn it mediates the relationship between PM and mass customisation. This relationship is facilitated through the use of structural coordination techniques allowing the provision of common language, the alignment of functional objectives and the elimination of communication barriers.

In line with these authors, Lau et al. (2010b) take one step further to investigate the dynamic relationship between PM and II. Comparing their five case companies, their findings strongly suggest that the PM and SCI (i.e. internal, supplier and customer integration) relationship is affected depending on the level of module/component novelty. They contended that the need to overcome technical problems and specifying interfaces arisen due to the innovative nature of module/part makes a tight integration across the supply chain an imperative. As for the technical knowledge leakage factor, they suggested that knowledge intensive product development requires a tightly integrated SC in order to ensure the modular system functionality (Griffith et al., 2009). Team size was also found to affect the effect of PM on integration at a firm level through sub-dividing large teams into smaller team in which collective action is easily achieved (Pagell and LePine, 2002). And, with regards to supply chain efficiency (which is mainly concerned with on-time delivery) their findings suggested that in some cases module development organisations involved in more information sharing to achieve supply chain efficiency which led to an increased SCI. However, this result was not conclusive as this situation was not consistent across the case companies.

An interesting perception that was reflected in their findings was that “there is no clear cut linear relationship between PM and [integration]” (p.971). This observation suggests the dynamic nature of this relationship and implies that the degree of coupling within the supply chain rests on the level of parties’ involvement in leveraging integrative mechanisms for coordinating activities and decisions in the design and production of a product. Therefore, considering this dynamism and the diverse patterns observed in the impact of product architecture within the context of supply chain, it is considered simplistic to overlook its implications for the value-chain. In support of this, research also calls for revisiting the concept of PM in the value chain activities (Lau et al., 2010b), particularly at a firm level which appears to have been underdeveloped. This necessity was addressed earlier in the previous section in which it was argued that decisions about product architecture have important consequences for a firm’s internal and external structure and strategy. As such, it is crucial for these elements to be studied together in order to identify how the variations in one area influence decisions made in other areas. Given the focus of this research being on internal integration (II), the following section seek to shed more light on the implications of PM for intra-firm structure and the pattern of inter-functional communication.

### **2.6.5. PM, Organisational Design and Cross-Functional Communication**

Although the potential consequences of PM seem compelling and its implication for different aspects of supply chain is recognised by several scholars, empirical research demonstrating the effect of modular design as a product property on internal organisational structure is scant. As a result, its impact has largely remained relevant for inter-firm relationships. In addition, an increasing amount of anecdotal and empirical evidence on product and process modularity indicates the need to advance the extant literature on the association between PM and a firm's approach towards managing its business processes (e.g. Lau et al., 2010b). In this vein, determining the structural consequence of PM in the value chain has become a key focus of recent SCM research (Lau et al., 2010b, Ahmad et al., 2010, Droge et al., 2012, Felekoglu et al., 2013). While, literature has mainly suggested that modular architecture could impact organisational design (i.e. modular organisation based on the mirroring hypothesis), the findings have been inconsistent in terms of the degree of coupling across organisational ties (Colfer and Baldwin, 2016). This has given rise to the emergence of conflicting views on the alignment of product architecture and organisational structure. Since there is evidence in the literature that product architecture can alter supply chain configurations (Ülkü and Schmidt, 2011, Nepal et al., 2012, Pashaei and Olhager, 2015), this suggests that PM, by influencing the structure of value-adding activities, could create communication channels that support its corresponding activities. However, this moderating effect has not been empirically investigated.

Product architecture literature has advanced our knowledge about architectural knowledge embedded in modular products and some of its impacts on operational aspects of an organisation (Krishnan and Ulrich, 2001, Sosa et al., 2003). In this context, past research has frequently examined the relationship of PM with organisational design, and communication pattern (e.g. Schilling, 2000, Baldwin and Clark, 2000, Salvador et al., 2002, Sosa et al., 2004, Mikkola, 2006), focusing on the factors that enable or inhibit communication such as product and organisational structure misalignment, task structure, physical distance, etc. (e.g. Morelli et al., 1995, Van den Bulte and Moenaert, 1998, Sosa et al., 2002, Sosa et al., 2004). For example, exploring the implications of a modular system, Sosa et al. (2004) investigated how design interfaces map onto tasks structure and suggested that product architecture is a determinant factor in identifying the structure of communication within product development projects. Their empirical findings showed that cross-boundary team interaction is influenced by cross-functional modular design interfaces irrespective of their level of significance. Sanchez and Mahoney (1996, p.63) also suggested that modular product architecture creates an embedded “information structures that provide the glue that holds together the loosely coupled parts of a modular organisational design”. Yet, they are not embedded at the outset of the development process and require recurrent tasks implementation

to mature (Henderson and Clark, 1990). In addition, this information structure is manifested in communication channels within an organisation (Lau, 2009) which are shaped around those interactions that are critical to the tasks (Henderson and Clark, 1990).

It is evident that previous studies support that product architecture has some consequences for communication structure and the relative position of modularity in SCM literature has been empirically established. Yet, the question of whether PM acts as an enabler or inhibitor for cross-boundaries coordination and cooperation remains unclear. In addressing this question, two school of thoughts have emerged. The first takes a general view on PM implications and argues that in essence, PM could lessen the need for cross-functional/cross-unit coordination of individuals when coordination is embedded into ‘standardised interfaces’ (Pil and Cohen, 2006). In fact, this approach draws on the functional binding attribute of PM (Allworth, 2013) which allows for one-to-one mapping of teams interaction to physical component and argue that disintegration may occur due to the creation of more autonomous and independent task performing teams. Due to this implicit form of coordination (i.e. standardised interfaces) the members of a SC need to have a clear vision of standardisation issues and functional bindings (Allworth, 2013), which are the two key elements of PM, otherwise modularisation could be dysfunctional (Vickery et al., 2016).

Conversely, the second research stream takes one step further to account for the possibility of undocumented design interfaces and argues that although product architecture and design interfaces underline task interdependence (Morelli et al., 1995, Loch and Terwiesch, 1998, Terwiesch et al., 2002, Mihm et al., 2003, Sosa et al., 2004), in practice it is simplistic to expect “a perfect mapping between design interfaces and teams interaction” in complex product development (Sosa et al., 2004, p.1675). Sosa et al. (2004) contend that a modular product development could impose challenges to cross-boundary interactions due to design interfaces. This is likely arisen from the formation of team specialisation around modular designs. In fact, the development of complex product entails forming specialised cross-functional design teams assigned to design specific parts and systems (Ulrich, 1995). Forming these cross-functional teams involves the development of shared language fostering a form of team identity across the members of the team (Tushman and Katz, 1980). This situation could result in an organisational breakdown, thus creating communication and architectural knowledge barriers across the teams (Henderson and Clark, 1990, Sanchez and Mahoney, 1996, Van den Bulte and Moenaert, 1998). Nevertheless, to develop working systems, Sosa et al. (2004) propose that information exchange may take place through intermediary design teams, resulting in unmatched/indirect team interactions. These interactions are more likely to occur in complex products development due to knowledge asymmetry and ambiguity present in their design interfaces. Thus, the importance of cross-functional task-related interactions as well as the unmatched team interactions must be equally

emphasised. This is to imply that not all-known product-related interdependencies are effectively addressed by direct technical communication, but the indirect technical communication is also required to uncover undocumented interdependencies.

Due to the nature of the alignment issue, it is expressed that while it entails many benefits, a substantial use of PM may be less valuable in complex and dynamic environments, thus become counterproductive (Gomes and Dahab, 2010, Vickery et al., 2016). The problem is that the reliance on the functional binding may become problematic if both high modularity and complexity are coupled. Much of the literature that supports this statement indicates that “Modularity is a matter of degree” (Brusoni and Prencipe, 2001, p.183). For instance, depending on the level of maturity of a new technology or component introduced into a product architecture, the nature and structure of communication and interaction among key business functions could vary (Mikkola, 2007). That is, once a new technology or component matures and becomes standardised in product development process, PM increases compared to when the technology or component is first introduced into the product architecture. This is an indication of a transition from low to high modularity as a result of which the need for coordination and cooperation across business functions/units increases (Salvador, 2007). Following the logic of the second school of thought, this transition is likely to unfold new process interdependencies, imposing complexities, and enforcing the adjustment of the value-adding activities (Doran, 2003). Hence, a change in the structure of teams communication may follow as discrete customer requirements need to be incorporated into the key business processes. Therefore, it is argued that “organisations dealing with novel architectures, e.g. modular products, must understand how they manage the embedded knowledge of the products they develop. This is especially relevant in complex product development due to large number of both physical components and design participants involved in the process” (Sosa et al., 2004, p.1674).

Grounded on the above argument this research is interested to investigate how the adoption of modular product architecture could influence the effect of BPO on II in complex product development. While, a great deal of literature advocate that coordination embedded into standardised interfaces in modular products minimises human interactions and communication across internal SC members (Vickery et al., 2016), in dynamic business environments, complex process interdependencies may rise the need for both direct and indirect teams interactions (Sosa et al., 2004). If we assume that the adoption of both PM and BPO simultaneously creates a form of misalignment in organisational structure, an inhibiting effect may be imposed on communication pattern. So regardless of agreeing on the possible outcome of PM, this suggests that high modularity may become a potential barrier for a process-oriented organisation due to the need for restructuring the value-chain activities. This could particularly become problematic when there is complex process interdependencies

where the demand for visibility is high. Therefore, it is expected that the effect of a process approach on II may be contingent on the level of PM.

## **2.7.The Outline of the Research Gap and Research Questions (RQs)**

The current research studies internal integration (II) through situating it within a broader context of supply chain integration (SCI) in order to comprehend its scope, nature and the strategic role it plays in relation to other elements of integration. Having conducted an extensive literature review on integration the following research gaps were identified:

- Although, a great deal of research has been devoted to conceptualise II, evolving scopes and definitions of integration have resulted in mixed and, sometimes, contradictory findings pertaining the association between internal and external integration as well as integration and firm's performance. As such, II has remained one of the main challenges of the supply chain management (SCM) field, and it is frequently argued that it is the lack of internal cross-functional alignment that hampers effective SC efforts (Van Hoek and Mitchell, 2006). Despite many past inconsistent approaches regarding the dimensionality of integration, there seems to be a growing consensus amongst scholars treating integration as a multidimensional notion. However, there is still a lack of agreement on what elements constitute the main aspects of integration, leading the current research to critique the already existing theories because of the lack of either their consistency, extensity or applicability. This research associates the lack of consistency and extensity issues to a dominant tendency among scholars to study integration from a dyadic approach, in an attempt to identify dyad interfaces and examine their interaction. This is, however, a great departure from the main definition of II emphasising the participation of multiple functional areas in joint collaboration, interaction, etc. In terms of applicability, the literature lacks in providing the means to cultivate a dynamic basis in order to exercise already existing practices. Thus, the recommendations are mainly "directionally suggestive, rather than appropriately prescriptive" (Oliva and Watson, 2011, p.6). In a similar vein, a few researchers have also contended that while II offers significant benefits to companies and their SC in theory, they are yet to be established in practice (Christopher and Jüttner, 2000, Fawcett and Magnan, 2002, Power, 2005). This, although, is less evident in the product development literature as it has obtained a relative richness in proposing the techniques and practices resulting in intra-organisational integration (Pagell, 2004).
- In order to understand the underlying theoretical foundation of II, research in SCM was reviewed. The review revealed that in conceptualising II research has tended to replicate and operationalise the pre-developed frameworks and as a result has substantially

overlooked the relevance of business processes as a fundamental element of intra-firm integration. While, a limited number of recent studies have drawn the attention to the association between a process orientation and integration (e.g. Chen et al., 2009a, Flynn et al., 2010, Huo, 2012, Eriksson, 2015b), much of the current OM literature has developed on the role of processes in information technology (IT). Therefore, the relevance of a process-oriented approach for II remains an open question (Oliva and Watson, 2011). To address this knowledge gap, this research argued that by considering business processes and their associated characteristics in the context of integration, theoretical and empirical limitations which currently exist could be overcome. In essence, this approach is argued to act as a complementary mechanism to the extensive literature suggesting the enablers and drivers of integration by proposing a means to apply these practices. It could also provide support for the adoption of the SCM frameworks, i.e. GSCF & SCOR, developed for the purpose of achieving integration across business processes, and operational efficiency, respectively. Therefore, the ground for a new stream of research could be provided in SCI field, and the emerging body of knowledge focusing on a process perspective could be further expanded.

- In addition, drawing on a separate research stream, it was argued that II is a context-dependent notion and requires to be investigated through a different lens. In an attempt to synthesise the intangible contextual factors developed for II this research identified attitudes (Kahn, 1996, Lockstroem et al., 2010, Ghobadi and D'Ambra, 2012, Vallet-Bellmunt and Rivera-Torres, 2013) and patterns aspects suggested to form the underlying basis of business functions relationships (Lockstroem et al., 2010, Ghobadi and D'Ambra, 2012, Vallet-Bellmunt and Rivera-Torres, 2013). In this sense, it was broadly discussed that the exclusion of human element and its associated properties (e.g. attitudes, behaviour, orientations, etc.) could have detrimental effects on the SC system performance (Ellinger et al., 2006, Vallet-Bellmunt and Rivera-Torres, 2013, Tangpong et al., 2014). Being primarily about people, integration is grounded on the relationships happening cross-functionally and between individuals spanning several functional entities. Unlike a great deal of past research which mainly focused on technological aspects of integration, it was argued that a clear perception of cooperative interdependence should be in place for an effective information exchange and its systematic processing. This perception of cooperative interdependence has been characterised as referring to two fundamental dimensions of integration, namely attitudinal/relational and behavioural (Ernst and Fischer, 2014) which have been frequently neglected in defining II.
- Furthermore, despite the considerable importance of these contextual factors manifested in a range of management studies, such as organisational behaviour, OM, SCM, etc. (e.g. Shin et al., 2000, Stanley and Wisner, 2001, Stank et al., 2001, Gimenez, 2003, Jayaram

et al., 2004, Johnston et al., 2004, Prahinski and Benton, 2004, Fynes et al., 2005, Gimenez and Ventura, 2005, Baker, 2006), there is only a handful of papers integrating these factors with other relevant contextual elements which reflect the characteristics of a process approach (e.g. Pagell, 2004, Chen et al. 2009b, Lockstroem et al. 2010, Huo, 2012, Vallet-Bellmunt and Rivera-Torres, 2013, Leuschner et al, 2013, Eriksson, 2015b). Additionally, research has repeatedly called for II theory development, yet there seems to be a tendency among scholars to focus on the effect of II on firms' performance (Pagell, 2004). This has led to a shallow conceptualisation and operationalisation of this strategic element of SCI, resulting in the use of limited scales for its measurement (Fabbe-Costes and Jahre, 2007). As such, the need for theory development has been marginalised.

- Lastly, this research elaborated on the concept of product modularity (PM) and its association with organisational design and communication structure. Literature has long suggested that decisions about product architecture and supply chain design are deeply intertwined. The key challenge is to attune product and business processes in the SC in an attempt to address their interdependences that go beyond operational boundaries (Verdouw et al., 2010). This has created an extensive line of research arguing that decisions about key business processes are not independent of product architecture and its associated characteristics (Gomes and Dahab, 2010). Within this body of knowledge, the association between PM and integration has emerged as a topic of interest as whether modular product development requires tightly integrated SC ((e.g. Galvin and Morkel, 2001, Laseter and Ramdas, 2002, Nobelius and Sundgren, 2002, Gerwin, 2004, Lau et al., 2010a), particularly in the manufacturing sector (Fine et al., 2005, Antonio et al., 2009). Past research has broadly drawn on the mirroring hypothesis to define the causation for the effect of product architecture on organisational ties. In this context it has been argued that the need for extensive II may be diminished as a result of high PM. This is particularly explained by the effect of PM on the value-adding activities as a consequence of embedded coordination in standardised module interfaces, which may create a misalignment between organisational design and communications structure. The extent of this relationship is heightened when modularity is coupled with high product and process complexity. Although, this seemed to be a prevalent pattern, a separate school of thought has emerged, taking an opposite view and contends that to handle knowledge asymmetries in such business environments cross-boundary communication is augmented. Nevertheless, despite these discrete views research has come to terms with the implications of PM for the structure of business processes and communication mechanisms and patterns. Yet, it is not yet known whether PM has negative consequences for a process approach, despite the general consensus among theoretical and empirical researchers on the implications of modularity for the value-chain ties. In fact, one of the



major concerns in this context is to investigate whether PM creates a form of misalignment between process approach and cross-functional relationships. In light of such knowledge gap, research has called for revisiting the concept of PM in the value-chain. Therefore, this research seeks to cast light on the relationship between PM, process approach and II in order to understand how variation in one decision area affects the nature of decisions in other areas.

In addressing the above research gaps three research questions are formulated as follows:

***RQ1:*** “What is the relationship between business process orientation (BPO) and internal integration (II)?”

***RQ2:*** “To what extent taking a process-oriented approach could provide a dynamic basis underlying internal integration (II)?”

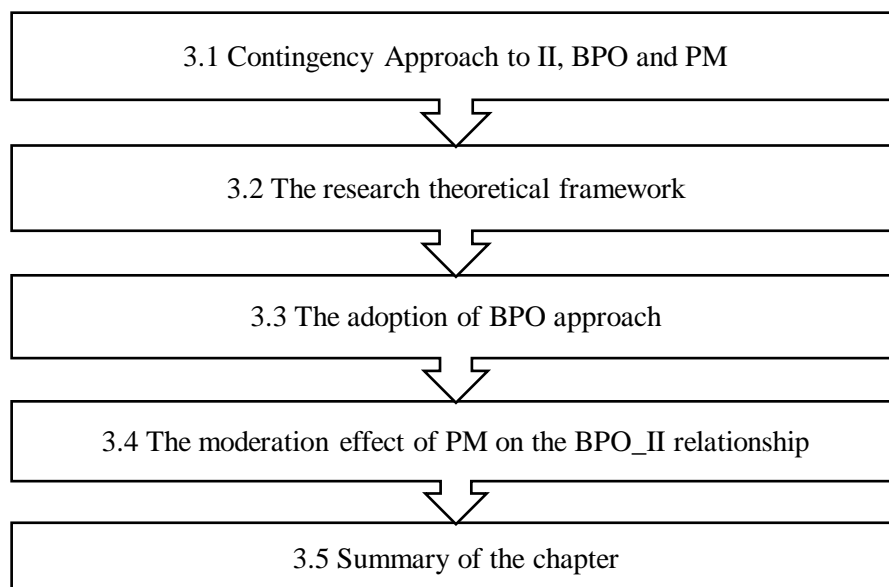
***RQ3:*** “Does product modularity (PM) moderate the relationship between business process orientation (BPO) and internal integration (II)?”

The following chapter provides the research theoretical framework seeking to investigate the relationship between the dimensions of BPO and II as well as the moderating effect of PM on this relationship.

## Chapter Three: Research Theoretical Framework

### 3. Introduction

This chapter seeks to propose a theoretical model in order to address the research questions presented in the previous chapter. It begins by providing a brief review of the contingency theory (CT) as the theoretical approach used to examine the relationship between the three key research constructs, i.e. internal integration (II), business process orientation (BPO) and product modularity (PM). Adopting BPO approach, the primary research theoretical framework is then developed, proposing three competing models informed by the literature through investigating the possible configurations of BPO elements in relation to II. This is followed by proposing a series of hypotheses on the direct, mediating and hierarchical relationships between BPO elements and II that will be empirically examined. This continues by providing an argument on the moderation effect of PM on the BPO-II relationship, and their associated hypotheses are proposed. The chapter is then completed by providing a summary of the key research theoretical relationships. Figure 3.1 briefly depicts the structure of this chapter.



*Figure 3.1. Summary of Chapter Three Structure*

#### **3.1. Contingency Approach to Internal Integration (II), Business Process Orientation (BPO) and Product Modularity (PM)**

Contingency theory (CT) has been reported as the major theoretical lens adopted to observe organisations. In its most basic form, “this theory holds that organisations adapt their structures in order to maintain fit with changing contextual factors, so as to attain high

performance” (Sousa and Voss, 2008, p.2). Operations management (OM) field has revealed a growing consensus among scholars about incorporating theories from other fields such as management, organisation, and economics theory in order to draw useful insights (Amundson, 1998). “This trend is linked to the realisation that many OM problems have a cross-disciplinary nature and has led to broadening the scope of OM field and the desirability of conducting interdisciplinary research” (Sousa and Voss, 2008, p.2). It is argued that as OM best practices have become mature, research has begun “to [...] shift [...] [its] interest from the justification of the value of those practices to the understanding of the contextual conditions under which they are effective” (Sousa and Voss, 2008, p.2). Therefore, this theory is adopted in the current research since research interest has begun to shift from justifying universal integrative practices to understanding the contextual conditions in which they are appropriate (Sousa and Voss, 2008).

From Dubin (1976) perspective every theory is grounded on the CT since the theoretical boundaries drawn when constructing theoretical models are based on certain initial assumptions in order for the propositions to hold. Nevertheless it is argued that a distinction must be made between CT and other theories (Drazin and Van de Ven, 1985). For example, Fry and Smith (1987) compare CT with congruent propositions and clarify that the latter holds unconditional relationships between variables, while the former assumes conditional associations between the variables in a theoretical model. In other words, their association “is directly subjected to an empirical test” (Drazin and Van de Ven, 1985, p.514). On this ground, it can then be argued that success in attaining II is contingent on the level of a process-oriented approach adopted by a firm. Thus, according to what the CT postulates, being an organisation internal strategy, II should fit its business processes which determine the organisational design and structure. This could further be moderated by PM (contingent) in dynamic and complex environments.

This theory postulates that there must be an alignment between an organisation competitive status and the strategy and structure it adopts (Rogers et al., 1999, Cadez and Guilding, 2008). Moreover, certain contingency factors determine an optimal organisation style in each firm, thus there is no best way of managing all organisations (Škrinjar and Trkman, 2013). According to structural CT, organisational-level strategy is influenced by the organisational and individuals work and decision-making structure (Hollenbeck et al., 2002). For example, in relatively predictable and stable environments a functional departmentation structure which fits an undiversified strategy performs better. In such business environments the key focus is to align all business activities with a single product or service and as such functional specialisation is sought to enhance efficiency. In contrast, a divisional departmentation structure fits a diversified strategy, allowing diverse activities to serve various product-markets (Donaldson, 2001, Hollenbeck et al., 2002). In such situations, intra-

department coordination will lead to an improved effectiveness. Hence divisional structure creates broader and more independent role which performs better in unstable and unpredictable environments (Hollenbeck et al., 2002).

The notion of fit forms the most important aspect of CT and is categorised into three categories including selection, interaction, and system approach (Ebrahimi, 2015). Drawing on the importance of these forms, it has been argued that theory development, data collection and analysis are influenced by the type of fit investigated (e.g. Venkatraman, 1989, Colquitt and Zapata-Phelan, 2007, Flynn et al., 2010). Therefore, each category could significantly alter the implication of the CT for an empirical research results (Drazin and Van de Ven, 1985).

In a systemic analysis of the current state of OM research incorporated CT, Sousa and Voss (2008) shows that the primary fit approach adopted for OM practices is selection. Selection approach merely investigating context-response relationships is recognised to present “a basic assumption underlying congruence propositions between organisational context and response variables” (p.706). Drawing upon the interaction approach, fit is interpreted as the interaction effect of different context-response variables on firms performance (Sousa and Voss, 2008). In both selection and interaction approaches the main focus is on examining the effect of contextual factors on response variables in isolation of other involved factors. While, a system approach takes a more holistic view, arguing that the contextual factors are all interrelated and operate in an interdependent relationship. Thus, their isolation from other factors does not provide a true reflection of their effect on a firm’s performance (Drazin and Van de Ven, 1985, Sousa and Voss, 2008). It is, hence, suggested that in order to establish an effective organisational design, contingencies, contextual factors and performance criteria are required to be incorporated, simultaneously.

Given the context diversity existing in today complex business environments, one concrete framework does not necessarily fit with all situations (Vom Brocke et al., 2016). Identified as context-dependent the application of business process management (BPM) principles (i.e. BPO) leads this research to take a contingency perspective on theory building in managing an organisation and its processes (Trkman, 2013). Based on this context-dependent nature of process management, it is argued that CT could serve as an effective framework supporting that there are several ways of applying BPO contextual factors, allowing for the development of distinct conceptual models (Vom Brocke et al., 2016). Indeed, it challenges the more conventional management approach assuming that the optimum course of action is dependent/contingent on one best method in all situations, regardless of their different levels of complexity. Additionally, CT renders a flexibility to consider both a micro as well as macro level of analysis, such as individual tasks/functional units and SC as a whole, respectively (e.g. Stonebraker and Afifi, 2004, Overby, 2008, Trkman, 2010). As such, both

SC as well as its constituent sub-units (e.g. structure, individuals, functions, etc.) are seen as part of an interconnecting network, which have interaction with each other and their environment (Melao and Pidd, 2000). Therefore, considering the context-sensitive feature of BPM approaches, it is particularly crucial to adapt BPO development to the nature of a firm's business process (Melão and Pidd, 2000, Vom Brocke et al., 2014, Vom Brocke et al., 2016).

Drawing upon the primary focus of this research which is to investigate the relationship between the dimensions of BPO and II, selection approach to fit best suits their underlying theoretical association (which will be discussed in the following section). The interaction approach focusing on the interaction effect of predictors on a response variable does not support this relationship, thus is not deemed appropriate. In addition, the system approach does not seem to fit with the main purpose of this research since the aim is not to examine the effect of this relationship on performance. Furthermore, based on the debate presented in chapter Two this research seeks to investigate if the effect of BPO on II is contingent on the level of PM, thus the interaction approach to fit is applied in this relationship. The use of selection approach is in line with its compatibility to investigate the relationship between context variables and OM practices as emphasised by Sousa and Voss (2008). Notably, it could provide the basis for the future research to further expand on the proposed relationship by including performance variables. Additionally, the interaction approach examining the most fundamental relationships between organisational context and OM practices could also provide a substantial theoretical foundation that future research needs to consider when aiming to explore the implications of these relationships for performance. Furthermore, with using the CT, this research aims to further emphasise on this view point that "OM field is strongly based on a contingency paradigm" (Sousa and Voss, 2008, P.698), particularly in the study of OM practices. Next section will develop the theoretical framework, followed by presenting the research hypotheses.

### **3.2.The Research Theoretical Framework**

So far, this research has attempted to establish an understanding of the common ground for the two concepts of process approach and II emerged from two discrete literature. It was argued that the growing competitive business environment have forced firms to adapt to new circumstances in order to survive. The dynamic nature of these business environment also requires the reinforcement of social capital which is the building block of a business success. Therefore, firms are still seeking for ways to overcome the limitations of traditional functional approach which lacks the elements of agility and responsiveness to customer needs (Khosravi, 2016). While several management approaches and techniques have been developed to manage the intangible aspects of a business, it is argued that many organisations still lack

sufficient resources available to manage relational, structural and human capital aspect of their business (Kujansivu and Lönnqvist, 2008). Literature review broadly indicated that process approach has become a significant technique in managing inter-firms collaborative activities because of the incremental trend towards an end-to-end/system-wide business structure. However, this trend seems to have been constrained at an inter-firm level, thus research in operations management (OM) has remained at the early stages in the domain of process approach and its effect on intra-firm integration. As such, some of the perceived benefits of a process approach at an organisational level (i.e. improved cross-functional collaboration and market responsiveness, the alignment of business objectives, etc.) have remained relevant within the theoretical scope (Kohlbacher, 2010).

Despite the general agreement among scholars on the importance of integration within the context of SCM, achieving internal integration (II) has been a challenge in practice, leading to mix results. It is evident that a broad research has explored II and proposed different conceptualisations, yet we still have an incomplete understanding of the means to achieve integration. In particular, the effect of a process approach on II has been left underdeveloped. On that account, this research seeks to address this knowledge gap in the literature through investigating the association between BPO and II. Furthermore, this research draws on the concept of product architecture and its implications for the supply chain design which is receiving an ongoing attention in the manufacturing sector. Within this literature, the relevance of product modularity (PM) was reviewed and it was discussed that although PM has shown to reduce the need for cross-boundary communication due to embedded information structure in standardised module interfaces, it could have negative impacts on II through altering organisational design and structure, particularly, in dynamic and complex environments. In other words, this research argues that PM which could dictate a firm's internal communication pattern may become a conflicting factor for II when coupled with a process-oriented approach due to the complexities involved in product and process interdependencies in these environments.

Grounded on the above arguments, the overall aim of the present research is to provide a new theoretical understanding of the concept of II through adopting a process approach and its interplay with the product architecture characteristic. To achieve this three key objectives are outlined as follows:

- A. To develop alternative competing models, and empirically assess the relationship between BPO and II and thereby identifying the most well-established model, given that this research is at its early stage (of preliminary nature),
- B. To study how PM moderates the relationship between BPO and II in a complex manufacturing environment, thus shedding more light on the implications of modularity for integration,

- C. And, lastly, to develop a theoretical model grounded on the first two objectives in order to further expand the existing research on integration, and therefore advance the current knowledge and perception on the means to exercise already existing integrative practices and achieve an effective II.

### **3.3.The Adoption of Business Process Orientation (BPO) Approach**

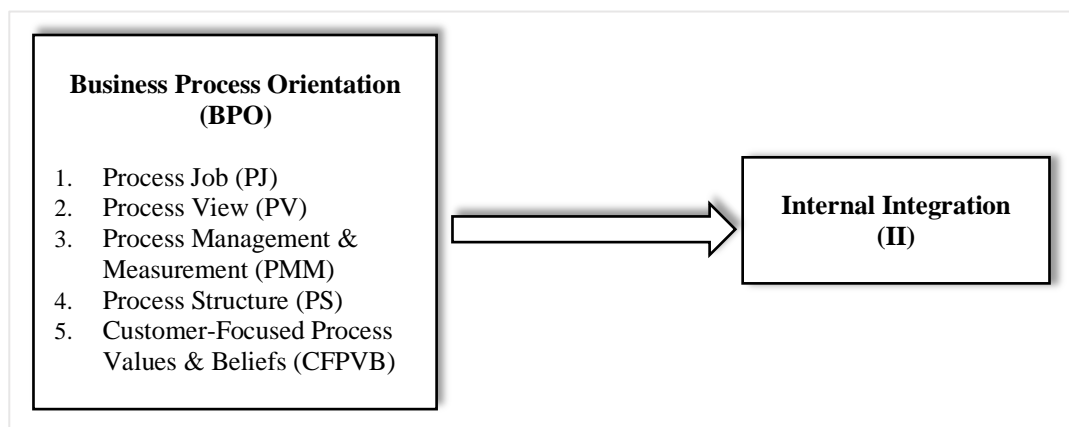
“Processes can be seen as having the structural characteristics of networks that facilitates the flow of information and the movement of people or materials” (Llewellyn and Armistead, 2000, p.225). The extant literature revealed that business processes need to become a highly integrated interface for collaboration, cooperation, communication and interaction across business functions. Trkman et al. (2007, p.19) who call for an assessment of business processes states within SCI note that “the core idea is that the successful implementation of [SCI] projects is not as much a technological problem”, but it rather involves business process evaluation. It is emphasised that companies should remove functional barriers and become more process oriented. This entails bringing together business functions involved in key business processes within an organisation to interact and communicate cross-functionally in order to endure SCM problems and survive (Zacharia et al., 2014).

A process-oriented organisation implies the development of clear goals and communicating performance outcomes (Willaert et al., 2007). It is argued that when performance goals are clearly communicated, “a self-enhancement motivational system is activated whereby employees perceive enhancement of one in the eyes of the self and others” (Whitaker and Levy, 2012, p. 161). It is believed that, process orientation provides an integrated approach which includes organisation strategies, its structural aspects as well as information technology systems (Dülger, 2018). Together these views indicate that process orientation may be seen as significant for the attainment of integration across functional entities through influencing the patterns of interaction and communication. Indeed, it is argued that BPO provides the means to better serve II needs and as such allows to exercise the current integrative practices. Thus, by developing a process-based organisation one can expect a better and more effective achievement of integration at an organisational level.

Scholars have provided different definitions of BPO (Glavan, 2011), yet this research adopts the most extensive definition provided by McAdam and McCormack (2001) as the level of an organisation’s emphasis on its core processes which require an end to-end approach. This approach creates a customer-focused mind-set promoting a process-oriented structure which could effectively result in a fundamental transformation in jobs structure, creating a common language for communication as well as a customer-oriented measurement

system (Draheim, 2010). In developing a SC maturity model, Lockamy III and McCormack (2004) contend that maturity is an inherent characteristic of processes which involves developmental stages. At an integrated level, the underlying substance of BPO approach is echoed, turning the firm focus into integrating various functional expertise for the purpose of leveraging their knowledge in the value-adding processes (Davenport and Short, 1990).

In developing the theoretical framework, this research draws on the progressive nature of BPO approach through which processes are defined, managed, measured and continuously controlled, and thereby adopts the five most common dimensions of BPO initially proposed by McCormack (1999) and operationalised later by other scholars (see Appendix 4.2). Figure 3.2 depicts the research primary model in which process job (PJ), process view (PV), and process management & measurement (PMM) represent the basic elements and process structure (PS) and customer-focused process values, and beliefs (CFPVB) are the supporting elements. The supporting elements are suggested to provide the structural and cultural ground facilitating the function of basic elements. The research posits that these five elements form a dynamic basis underlying an effective II.



*Figure 3.2. The Primary Theoretical Framework*

To briefly make a distinction between BPO adopted in this thesis from business process management (BPM) literature and other process-oriented approaches employed in other management fields, this research refers to business process reengineering (BPR), and enterprise resource planning (ERP) which have extensive literature investigating their impact on integration. While, BPO being a central element of BPM implementation is a management concept focusing on business processes (Smart et al., 2009, Kohlbacher, 2010), BPR and ERP are two process modelling tools with a focus on IT solutions supporting BPM initiatives (Al-Mashari, 2003, Jeston and Nelis, 2014) and have been used for many years for the purpose of integration across the SC (Tang et al., 2013). Unlike BPM and BPO which are continuous approach towards process evolution and improvement, BPR is a one-off change concerning a



radical process re-design and improvement (Vergidis et al., 2008, Trkman, 2010, Kohlbacher, 2010).

### **3.3.1. Competing Theoretical Models**

Gaining an understanding of a phenomenon may involve at least three forms of intellectual methods, including ruling theories, working hypotheses and multiple working hypotheses (Chamberlin, 1965). The first two approaches mainly rely on proving a tentative theory to reach an explanation of a proposed relationship. They fail to consider alternative hypotheses which could disprove the original tentative hypothesis, thus leading a researcher to insist in proving what is evidenced to be false. To safeguard against this false impulse, Chamberlin (1965) proposed multiple working hypotheses approach which allows for considering alternative and sometimes contradictory hypotheses to capture a true indication of the reality. Therefore, more meaningful results are obtained, preventing the researcher from overlooking other lines of enquiry. In considering this method, this research study follows a competing model approach employed by Krueger Jr et al. (2000). As such, alternative competing models are proposed to examine their relative ability in explaining II, thereby identifying the most well-established model (Krueger Jr et al., 2000). Taking this approach in theory development is in line with the preliminary nature of this research study which is an initial step towards identifying a means to achieve II.

Consistent with the contingency theory (CT), it is important to emphasise that one scenario does not fit all situations. Thus, depending on the business environment the scope and engagement within BPO development may vary (Jeston and Nelis, 2014), resulting in alternative relationships between BPO and II. Based on the primary framework (Figure 3.2), three variations of the BPO-II relationship are derived; The Parallel, Mediation and Hierarchical Models. These models are informed by earlier theoretical understanding of BPO development. The Parallel Model (see Figure 3.3) takes into account the simultaneous development of the five factors and their direct relationships with II. This model is essentially informed by the original study conducted by McCormack (1999) and assumes that the parallel development of the five dimensions provides the dynamic basis to achieve II. The Mediation Model (see Figure 3.4) draws upon the significance of structural and cultural ground in supporting and facilitating the institutionalisation of the three basic elements. Indeed, this model proposes that the effect of supporting elements on II is mediated through the basic elements. And, finally the Hierarchical Model (see Figure 3.5) based on a staged sequence of the basic elements, is proposed to reflect on the concept of Key Turning Points (KTPs) in BPO maturity model discussed in chapter Two. This model argues that the basic elements should be developed hierarchically than in parallel/or as a combination in order to provide the dynamic basis of II. In other words, for an organisation to move across the BPO maturity path

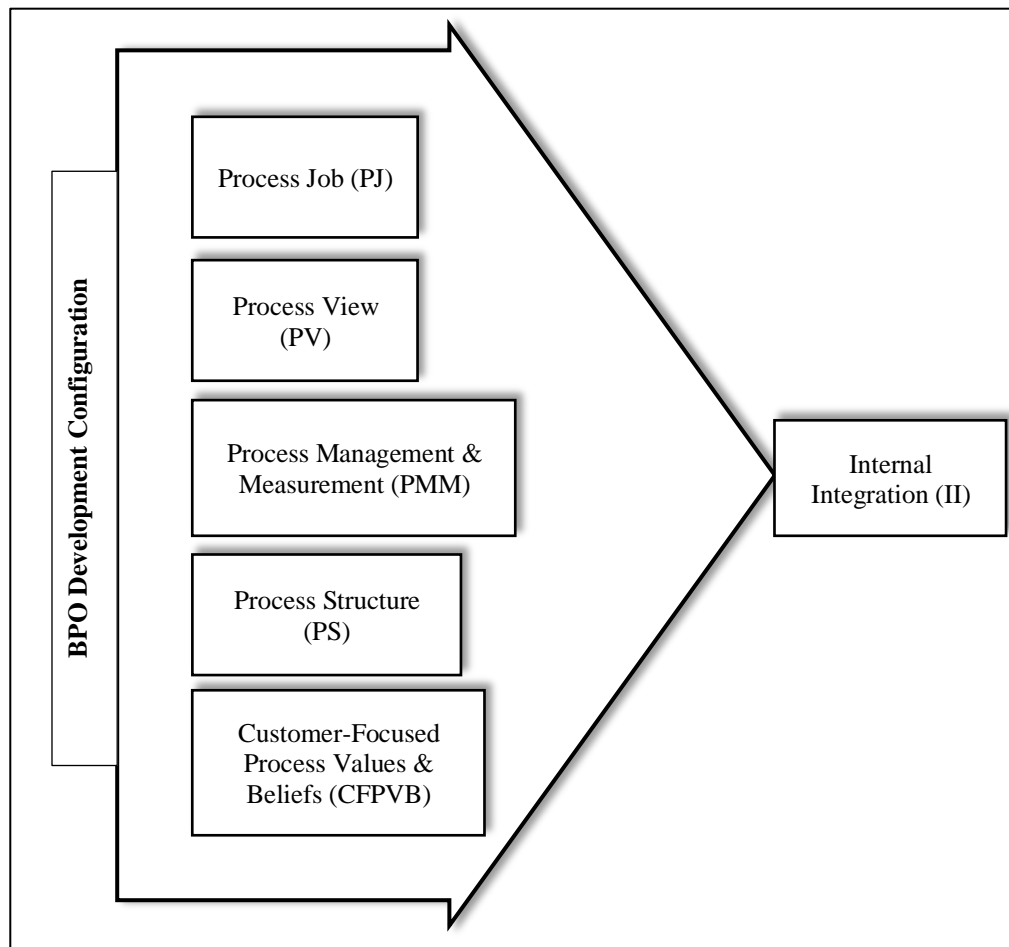
process job (PJ) should first be established and stabilised followed by the development of process management & measurement (PMM) and process view (PV), respectively. In addition, each stage should be accompanied by the two supporting elements to create a foundation for the three basic elements operating interactively. The conceptualisation of each model is further articulated in the following sections.

### **3.3.2. The Parallel Model**

Earlier, it was mentioned that process orientation involves some steps through which a process is defined, managed, measured and continuously controlled. Literature has reported a high failure rate of several process orientation projects attributed to the lack of sufficient attention to human aspect of BPM initiatives (Khosravi, 2016), and as such process approach has been criticised to be an effective technique in theory and remains impractical when it comes to its execution (Zairi, 1997). The core argument in this body of knowledge is that the dynamic nature of business processes and their attributes requires a gradual development of process orientation in order to prepare people to practice the changes (Jeston and Nelis, 2014). In line with this, Kokkonen and Bandara (2010) develop a comprehensive BPM model and argue that people factor is a key predecessor for the successful and effective development of BPM (Kokkonen and Bandara, 2010). Palmberg (2010) also argues that although process view has become a common management approach, many organisations have faced problems developing and maintaining its practices because of overestimating the technical parts such as process mapping and documentation technique. The fundamental issue with this mechanic view to process orientation is that the constructive dynamic created by people participation is undermined.

Within this body of knowledge there is a growing understanding that developing a process-oriented organisation is not a revolutionary event, but it rather involves a gradual and parallel institution of its components which may overlap and intertwine (Jeston and Nelis, 2014). In fact, it is suggested that process orientation is gradually evolved to achieve a desired level rather than some rigid sequential activities occurring in order. The parallel evolution of process elements allows a high level of participation from people who are the building block of organisational change and execute BPO tasks (Al-Mashari and Zairi, 1999). This could result in significant and positive changes during the implementation, given the overlapping characteristics of the BPO elements. This approach has been adopted in a number of empirical research which identify the composition of process-oriented initiatives as a success factor to their implementation (Alves et al., 2018). Therefore, it emerges from the above discussion that an effective approach to BPO development may need to rely on the simultaneous institutionalisation of its elements to best serve internal integration (II). Thereby, this research

argues that the parallel development of BPO elements creates a constructive dynamic for an effective attainment of II. Therefore, the Parallel Model is proposed in Figure 3.3.



*Figure 3.3. The Parallel Model*

The main emphasis in this model, which represents a simple composition of the BPO-II relationship, is on the simultaneous development of the five elements of BPO. Indeed, this model contends that if BPO elements are not established in parallel it may become problematic for an organisation to realise its true effectiveness and as such its relationship with II could be affected. Hence, BPO elements are evolved simultaneously to support the identification of value-adding processes and decision-making procedure. Grounded on the Parallel Model, the following sections will elaborate on the individual effect of each BPO dimension on II.

#### **3.3.2.1. The Direct Effect of Process Job (PJ) on Internal Integration (II)**

A process-based organisation has been perceived to enable the elimination of redundant hierarchies through removing non-value-added activities, creating a more flattened hierarchical structure (Ostroff, 1999). It represents a more simplified organisational structure

in which tasks are multidimensional and designed to contribute to value-adding processes (Kohlbacher, 2010, Tang et al., 2013). It is argued that while a process-based organisation has come to broaden jobs responsibilities (Russell and Hoag, 2004, Hernaus, 2008b), a functional-oriented organisation in which jobs are not fully defined across processes lacks the element of ownership, failing to appreciate customer orientation (McCormack and Johnson, 2001a). Research has suggested that a process-oriented organisation involves the synthesis of expertise from different functions within an organisation through promoting process job (PJ). Therefore, making a process oriented organisation does not only influence the logical structure of business process relationships, but employees are also assigned new roles and responsibilities and are held accountable for their process outcome (Willaert et al. 2007).

Process job (PJ) is related to horizontal task assignment and underlines teamwork where the members of different functions take a process ownership (Lockamy III and McCormack, 2004, McCormack, 2007, McCormack et al., 2009). A process owner might be titled as, for example, “supply chain team member”, “order fulfilment process owner”, etc. (McCormack et al., 2009, p.795) and is assigned to focus on and manage a particular process (Gupta, 2011). Processes are supported by a process team which contains the experts/employees from key functions or delegates of other processes (Kujansivu and Lönnqvist, 2008). It is argued that in a process-based organisation effective teamwork is established within a process team in which social interaction is performed based on shared values and purposes (Zarei et al., 2014). Processes are required to be established and preserved by a designated manager (Lindfors, 2001) who takes end-to-end accountabilities to get the jobs done (Kohlbacher, 2010). Not only managers but also team members should actively get involve in supporting key business processes and participate in their efficient execution. PJ provides the means to empower employees and creates a self-directing work environment, while also offering some degrees of flexibility for them to adapt to changing job requirements (Tomasko, 1993, Vanhaverbeke and Torremans, 1999). Although, this flexibility may come at the expense of increasing the complexity in decision-making process through functional diversity which creates distinct and sometimes conflicting ideas (Sethi, 2000), the use of effective managerial tools to reconcile differences of perspective could turn it into a competitiveness. This is notably important given the growing transition from functionally divided organisations to team-based and cross-functional working (Bassett-Jones, 2005).

In contrast to the traditional view of job design in which tasks identification and allocation were conducted based on the level of individuals competence and specialisation (Sparrow, 1998), a process-based organisation focuses on redesigning tasks structures through eliminating non-value-added activities, delegating authority and decision making to lower level employees and integrating workflow (Ostroff, 1999). Hernaus (2008) studies process orientation within level perspective and distinguishes the implications of a process-oriented

organisation at organisational, unit and individual levels. He indicates that at an individual level process orientation practices influence the content of jobs, skills requirement and responsibilities, and as such autonomous work teams and flat hierarchies emerge at unit level. Accordingly, it provides a broad overview of process architecture at an organisational level where the key processes objectives and their common interfaces are identified.

The introduction of process approach gives rise to an increased clarity in responsibility and organisational structure, followed by the creation of process owner. It is argued that employees perceive role clarity and clarifying expectation as constructive and valuable behaviours performed by managers (Schnake et al., 1995), which leads employees to engage in reciprocal behaviours and find themselves obliged to make positive contributions to the workplace (MacKenzie et al., 2001). In support of these perspectives, Whitaker and Levy (2012) propose that role clarifying information may promote prosocial attitudes as a result of reduced uncertainty and addressing employees concern around success and welfare. In addition to the enhanced role clarity for employees, PJ may develop and maintain decision-making capability through averting the centralisation of information and power around specialisation. It is argued that in an environment where employees are expected to monitor and respond to unexpected events, hierarchical jobs may fail to cope with such situation due to lack of jobs rotation and workers familiarity with the whole process. In contrast, a horizontal task structure which promotes jobs rotation is suggested to provide a high degree of delegation of decision-making power to employees which encourages cooperative behaviour and joint problem solving (Aoki, 1986). As such, they develop and maintain direct relationship with their counterparts across the process and their ability to cope with work interdependence is elevated.

Research has endorsed that joint activities such as joint decision making, joint problem solving, and joint responsibilities are some of the main elements of inter-departmental integration (Vallet-Bellmunt and Rivera-Torres, 2013). Based on this assertion and grounded on the above argument this research argues that by attaining an appropriate level of PJ through developing a process-oriented organisation, a company is able to promote process ownership and horizontal job responsibilities beyond complex hierarchical structure, and thus create a dynamic basis for an effective II. Therefore, the following hypothesis is formulated:

***Hypothesis 1.a (H1.a +): “The degree of process job (PJ) has a positive impact on the degree of internal integration (II).”***

### **3.3.2.2. The Direct Effect of Process View (PV) on Internal Integration (II)**

Within the context of SCM, it has been argued that as companies are shifting from function-oriented to a process-oriented management approach in response to competitive trends, there is an increasing need for improved transparency in defining processes and their effective implementation (Stewart, 1997, Lindfors, 2001). In reaction to these requirements past research has emphasised on leveraging a well-structured and communicated process architecture in an enterprise (Movahedi et al., 2016). In shaping and managing works around business processes, a precise definition of key processes and their relations is required. With the aim of addressing these requirements, process architecture determines the way technology is utilised, the level of each function centralisation and decentralisation, and their inter-connection with multiple units, their suppliers as well as customers. More precisely, it aims to provide an overview of the business processes and their value contributions to customers through “[defining] the basic physical building blocks of the company’s processes in terms of what they do and what their common interfaces are” (Hernaes, 2008, p.7). Process view (PV) is the means by which a process-oriented organisation defines, documents and maps its business processes. According to Lee and Dale (1998) this procedure involves an end-to-end modelling of processes in a way that links them with customers. This way, it provides the opportunity to optimise the dynamic structure of an organisation which is potentially absent in a traditional organisational chart depicting the static aspect of a business structure (Johansson et al., 1993).

Research has indicated that a prominent instrumental outcome of PV is that it promotes a prevailing communication and interaction method/language for individuals with different skills and expertise (Kahn and Mentzer, 1998, Ellinger, 2000) through using process documentation. Process documentation has emerged as a theoretically powerful tool to develop standard operating procedure where the relationships and interactions among multiple operations could be seen (Bae, 1993, Symons and Jacobs, 1997). In an organisational environment that provides standardisation through process documentation firms could take advantage of operational consistency, reduced conflict among employees and training improvement of new employees (Ungan, 2006). Process documentation has been linked to significant process improvement purposes, in particular, process efficiency and simplification. These objectives are supported by detecting value-adding activities and removing unnecessary and non-value-adding processes while providing a broad picture of business processes. In this sense, it is also argued that with the means of PV jobs clarity and processes transparency are increased and the element of “out of sight, out of mind” is eliminated (McAdam and McCormack, 2001, p. 17). Similarly, Lee and Dale (1998) indicated that process documentation allows to define and support “the needs of process participants. This includes in-process control measures, document and information usage, management controls and a

description of how to complete the process” (p.219). Enhanced role clarity achieved as a result of process documentation and visualisation illuminates each function’s responsibilities and contribution to the end results (Tang et al., 2013), and enhances employees involvement in business process execution (Willaert et al., 2007). This is argued to promote participative decision-making as well as a cooperative approach towards conflicts resolution (Kahn and Mentzer, 1998, Ellinger, 2000). Furthermore, with visualisation, an insight into process complexities is provided and employees recognise process inputs, outputs as well as internal and external suppliers and customers (Kohlbacher and Gruenwald, 2011a). This increased familiarity with business process elements is likely to improve their efforts and commitment and enhance their goal pursuit.

The relevance of PV has been theoretically advocated in improving employees communication (e.g. Melan, 1989, Willaert et al., 2007). For example, Willaert et al. (2007) argue that “documenting and communicating the business processes is a [...] means for improving communication across the organisation”. Likewise, Johansson et al. (1993), McCormack et al. (2009), and Movahedi et al. (2016) hold similar view and posit that PV renders a tool for employees to interact and communicate proactively on a company wide basis, using the same language/vocabulary. Empirical evidence has also suggested that process documentation has important implications for knowledge and information integration. For example, Aysolmaz and Demirörs (2014) adopted business process modelling as a method of defining and documenting process requirements and concluded that process modelling could result in aligning knowledge captured from business processes with user requirements and as such one can expect streamlined end-to-end business processes, while also experience an effective communication environment with end customers. Within the context of product innovation process, Wells (2008) refers to process standardisation and market intelligence documentation as some of the knowledge integration mechanisms through which cross-functional knowledge held by individuals could be exploited and integrated for new product development.

Therefore, this research argues that by documenting and mapping processes, their objectives and key requirements, PV attempts to promote a common language for effective communication and interaction across the border of an organisation. This stimulates employees to align their actions with their underlying objectives (Lederer et al., 2015), thus a basis could be provided for an effective II. Hence, the following hypothesis is formulated:

***Hypothesis 1.b (H1.b +): “The degree of process view (PV) has a positive impact on the degree of internal integration (II).”***

### **3.3.2.3. The Direct Effect of Process Management & Measurement (PMM) on Internal Integration (II)**

Extant management literature has widely recognised the need for introducing a performance management system to align business processes with the overall firm's strategy (Neely et al., 1995). Although, process performance can be analysed from different perspectives (e.g. financial), they may "lack the inherent variety to give decision-makers the range of information they need to manage processes" (Willaert et al., 2006, p.741). It is argued that effective performance measures derived from customer specifications (Gunasekaran et al., 2001) could create a measurement system that is multidimensional which allows for performance management at both team and individual level (Foerstl et al., 2013). In becoming process-oriented, firms need to be equipped with an accurate performance measurement system which guides managing, measuring and controlling process performance and ensures their alignment with business objectives (Willaert et al., 2006).

In an attempt to address the above necessity and in response to the dynamic nature of processes, some early (Kueng, 2000) and recent researchers (Gleich, 2011, Glavan, 2011) within BPM context have come to investigate and reinforce the strategic role of PMM in a process-oriented organisation. Some empirical research has confirmed the implications of process-centred performance measure system for both financial and non-financial performance (Vera and Kuntz, 2007, Kohlbacher and Gruenwald, 2011a, Kohlbacher, 2013). For example, Kohlbacher and Reijers (2013) study the individual effect of BPO dimensions on customer satisfaction, product quality, etc. and suggest that PMM has significant and positive associations with the organisational performance indicators. Hernaus et al. (2012) provide empirical evidence on the specific influence of process performance measurement on both financial and non-financial indicators, such as employees and customers satisfaction. Their findings confirmed a positive and strong relationship between PMM and non-financial performance. For example, they reported PMM helped reduce the response time to customer complaints and facilitated the development of mutual trust with suppliers. It was also indicated that PMM affect financial performance indirectly through non-financial indicators.

Performance measure has been viewed as facilitating cross-functional communication and interaction through uncovering inefficiencies (Foerstl et al., 2013), goals integration (Rozemeijer, 2008), revealing internal functions contribution to value-adding activities (Moses and Åhlström, 2008), etc. Foerstl et al. (2013) demonstrated that by establishing a mature performance measurement system, firms could achieve a means to develop an advanced level of cross-functional integration. Following the logic of a mature performance management (Kueng, 2000), a process-oriented measurement system reflects a firm's key performance indicators (KPIs) derived from business objectives (Kohlbacher and Gruenwald, 2011b) and is concerned with a customer-driven and result-oriented measurement system



(Hammer, 1900, McCormack et al., 2009). Process performance lies at the heart of PMM (Beretta, 2002) by which the level of employees commitment to process outcomes is measured (McCormack, 2007, Willaert et al., 2007). Decision making in a process-oriented organisation, in which multidisciplinary teams are prevalent, is decentralised, creating a holistic view to performance management (McAdam and McCormack, 2001, Vos et al., 2011). This could encourage employees to operate towards the improvement of overall business performance rather than a series of fragmented functional goals (Beretta, 2002). Consistent with this, it has been argued that “appropriate performance indicators encourage employees to act in alignment with the strategic goals” (Glavan and Vukšić, 2017, p.141), and thereby preventing sub-optimisation as employees gain a sense of being part of an interconnected whole (Daft, 1995, Willaert et al., 2007). Within this line of research, Hammer et al. (2007) also argue that process measurement mechanism reinforces aligned and common focus across functional units and reduces the possibility of departmental segmentation. Some of the main reasons that cause this motivation among individuals include the direct communication of goals and outcomes with process team and improved resource allocation derived from assessing process requirements and objectives (Glavan, 2011). In this manner, PMM provides the ground for mutual access to information and available resources, fostering cooperative environment that virtually eliminates silos.

The above arguments provide evidence that PMM has an influence on the pattern of individuals behaviour activities and particularly on non-financial aspect of performance. In support of this statement, (Kaplan and Norton, 2001) also affirm that PMM represents accurate measures set on multidimensional aspects of business processes and as such it drives the way both managers and employees behave. On this basis, it is expected that PMM overcome the functional focus constraints, providing a cross-functional basis across an organisation. Thereby, it determines the extent to which II is achieved. It is, then, hypothesised that:

***Hypothesis 1.c (H1.c +): “The degree of process management & measurement (PMM) has a positive impact on the degree of internal integration (II).”***

#### **3.3.2.4. The Direct Effect of Process Structure (PS) on Internal Integration (II)**

For so many years the active role of organisational structure on building internal relationships has been the subject of interest (e.g. Stank et al., 1994, Daft, 1995, Holtzhausen, 2002, Pagell, 2004). Research has generally criticised a functional organisational structure to have a negative impact on cross-departmental communication. Vos et al. (2011) suggested that a functional structure could become a constraint to the adoption of cooperative activities. Despite these criticism, it is reported that the element of bureaucracies is still prevalent in many organisations in which task-related matters are usually the driving force of

communications. In these firms, relationships are mainly developed hierarchically within the scope of organisation chart (Ashkenas et al., 2002, Holtzhausen, 2002). Despite this predominant organisational structure in practice, theory has long realised the shortcomings against alternative structures leading to more effective task and resources allocation as well as interaction and communication mechanisms. One that has received substantial attention is a process structure in which activities and relationships are regulated around customers and questions the applicability of functional/product-oriented structure in today's dynamic business environment (Vanhaverbeke and Torremans, 1999, Pagell, 2004).

Process structure is a system of identifying process management teams and removing the functional-centric element of an organisation, thereby promoting an end-to-end business structure (McCormack et al., 2009). As already mentioned in the previous section, companies with a process structure tend to have a flat hierarchy, with the presence of process owners taking process responsibilities (McAdam and McCormack, 2001). While, process-oriented organisation has been recognised as a solution to functional and product-based organisational structure, a pure process-based structure may fail to address cross-process activities (Vanhaverbeke and Torremans, 1999), thus acting against the significance of functional specialisation (McCormack and Johnson, 2001). As such, some past scholars suggested a matrix model in their management system to allow for equal emphasis on both vertical and horizontal structure (e.g. McCormack and Johnson, 2002). Nevertheless, depending on the nature of business, firms might need to become more horizontally-oriented in order to organise employees around key business processes (Daft, 1995, Willaert et al., 2007).

For managers to overcome their functional bounded rationality, they require to reshape their mentality and appreciate cross-functional relationships and teamwork. In fact, this is recognised as the prerequisite for a boundaryless horizontal organisations (Ashkenas et al., 2002). Therefore, according to Pagell (2004) the organisation structure should be conducive to a streamlined flow of activities spanning several functions, thus minimising the creation of artificial borders such as constraining resource competition among key processes. Given that II essentially draws on practices involving joint activity development and decision making, information sharing, collective accountability, etc. (Vallet-Bellmunt and Rivera-Torres, 2013), in firms seeking to achieve an effective integration the structure should not create boundaries among operations (Pagell, 2004). Hence, implementing these cooperative activities need to be supported by an organisational structure in which tasks are organised horizontally (Willaert et al., 2007). An embedded horizontal structure (Willaert et al., 2007) enables decentralised decision making (Vanhaverbeke and Torremans, 1999) through the use of cross-functional teams mechanism (Sarin and McDermott, 2003, Pagell, 2004, Gunasekaran et al., 2004). Therefore, this research posits that as organisations attempt to use business processes as the platform for organisational structure, they obtain more flexibility in

drawing employees together and provide more open communication. This flexibility is regarded as an increasingly necessary factor within the context of SCM and determines the capacity of an organisation for promoting cooperative environment (McAdam and McCormack, 2001, Rao Tummala et al., 2006). Then, it is hypothesised:

***Hypothesis 1.d (H1.d +): “The degree of process structure (PS) has a positive impact on the degree of internal integration (II).”***

### **3.3.2.5. The Direct Effect of Customer-Focused Process Values, and Beliefs (CFPVB) on Internal Integration (II)**

With the increasing change to the model of management structure from a functional to a more process-oriented organisation, firms have significantly realised the importance of organisational mind-set and culture, particularly, in the field of organisational behaviour and human resource management (Majchrzak and Wang, 1996, Braunscheidel et al., 2010, Malekifar et al., 2014). In the era of such structural shifts, many organisations have reengineered their operations to embrace cross-functional business processes. This has consequently led them to address the issues relating to cultural changes in order to identify appropriate sets of values supporting the new mode of operations structure (Braunscheidel et al., 2010). While, it has received some theoretical attentions (e.g. Pagell, 2004, Malekifar et al., 2014), empirical research on the impact of organisational culture on II has been limited despite the proliferation of studies in the domain of supply chain integration (SCI) (Braunscheidel et al., 2010). Organisational culture is broadly defined as “a complex set of values, beliefs, assumptions and symbols that define the way in which a firm conduct its business” (Barney, 1986, p.656). Research generally draws a distinction between externally and internally-focused culture, and suggests that the former is concerned with an external positioning of the business and reward system which may advance a firm responsiveness to dynamic market environment and customers’ needs, while focusing on measurable goals and objectives (e.g. Quinn and Rohrbaugh, 1983, Deshpandé et al., 1993, McDermott and Stock, 1999, Hewett et al., 2002, Makhdoom et al., 2016). Whereas, the latter is associated with internal systems and people development (Quinn and Rohrbaugh, 1983, Deshpandé et al., 1993). While, factors that contribute to creating externally-focused culture are usually associated with rational and adhocracy culture, internal elements entail the hierarchical aspects of culture and mainly promote team spirits.

Despite the limited research in the extant literature, a number of empirical studies have shed some light on the association between organisational culture and a firm’s ability to adopt integrative practices (e.g. Braunscheidel et al., 2010, Cao et al., 2015, Yunus and

Tadisina, 2016). Braunscheidel et al. (2010) demonstrated that integration is negatively influenced by a firm level of hierarchy culture, which could result in a lower performance. Cao et al. (2015) also found that externally focused values and beliefs are strongly associated with a higher level of II. Their results suggested that while hierarchical culture negatively affects integration, a rational culture associated with a firm's reward system promotes a higher integration through incentivising employees (Ellinger, 2000, Braunscheidel et al., 2010).

Research into BPM has extensively evolved to intensify a growing awareness that process approach is not only concerned with technological aspect but also requires an understanding of cultural elements of business processes (Vom Brocke and Sinnl, 2011, Schmiedel et al., 2013, Hammer, 2015, Buh, 2016). The cultural element of process approach is perceived as "cutting through the isolated task-related silo mentality and calling for a cross-functional orientation on customer value" (Schmiedel et al., 2013, p.2). For a firm to adopt a process approach, individuals' mind-set needs to be in line with and support the organisational culture. Individual's mentality would appear in the way they interact with other functions and a more process-oriented mind-set would allow them to collaborate as a team, proactively (Willaert et al., 2007). This mind-set is characterised by the motive and interest in disseminating the key and relevant information across functional areas (Troy et al., 2008) and is affected by changes in the organisational structure (Näslund and Karlsson, 2004). It is only when cooperative habits are formed across functions that dysfunctional practices, such as pure functionally specialised structure, are avoided in tasks and responsibilities.

Accordingly, literature has theorised that a firm's cultural compatibility could become a bridge to facilitate supply chain collaboration (McCarter et al., 2005). Indeed, appropriate cultural values determine the way internal employees participate in teamwork, knowledge/information sharing and risk taking (McCarter et al., 2005, Cao et al., 2015). It is argued that firms with external cultural focus tend to have a prevailing customer or market-oriented approach (McDermott and Stock, 1999). Resting on this customer-oriented approach, CFPVB has been suggested to promote a culture of mutual trust, shared values and ownership among employees which drives the behavioural and communication pattern of process team. It also supports their commitment to continuous improvement and desire to attain ultimate organisational goals (McCormack et al., 2009). It is suggested that as the culture of trust and commitment are heightened among employees, they are more driven to seek further coordination (Bstieler, 2006). Therefore, taken together, it is proposed that by focusing on customers measures and requirements, CFPVB promotes cultural values that reinforce teamwork and cooperative setting. Accordingly, it creates an environment receptive for effective II. Thus:

**Hypothesis 1.e (H1.e +):** *“The degree of customer-focused process values and beliefs (CFPVB) has a positive impact on the degree of internal integration (II).”*

### **3.3.3. The Mediation Model: The Mediation Effect of the Basic Elements on the Relationship between the Supporting Elements and II**

With this understanding that the simple model proposed earlier (i.e. the Parallel Model) might fail in explaining the reality concerned with the BPO-II relationship, this section attempts to establish an alternative theoretical model to account for the possible complexity in the BPO development. In explaining this model, we draw on the systemic characteristics of BPM argued by some critics (Segatto et al., 2013) and integrate it with the central role of the supporting elements (i.e. culture and structure) in influencing process orientation initiatives. These characteristics are derived from the fundamentals of a systemic approach and take into account the inter-relationship between the elements of a process orientation (Segatto et al., 2013). “The essence of systemic thinking includes [...] [the] understanding [of] the inter-relationships rather than the linear cause-effect relationships” (p.702). It is argued that a reductionist approach isolating complex inter-relationships among causal factors to linear characteristics might be limited in understanding their true relationships and as such affect managerial decision-making procedure. In this sense, the adoption of systemic thinking in BPM initiatives is suggested to yield better results (Siriram, 2012). Although, systemic approach accounts for a wide range of contributing factors such as context, environment, resources, inputs, etc., this research uses this approach to only provide a theoretical explanation of the Mediation Model. As such, they are not included in the model conceptualisation and analysis.

Building on this systemic approach, the Mediation Model (Figure 3.4) considers the cause-and-effect relationship between the BPO elements. Indeed, rather than the individual impact of each BPO dimension on II with no particular order, this model focuses on the inter-relationship between the supporting and basic elements and the effect of this development structure on the level of II. This systemic view offers an alternative impression of the BPO development and may allow to obtain an understanding of the significance of the role of some leading factors on the others in order for the whole system to work. According to the systemic definition, this model argues that BPO as a system comprises of key element following common purpose to form the whole. So, for this system to emerge in its true possible shape one needs to ensure the alignment between both structure and culture with other process-oriented practices.

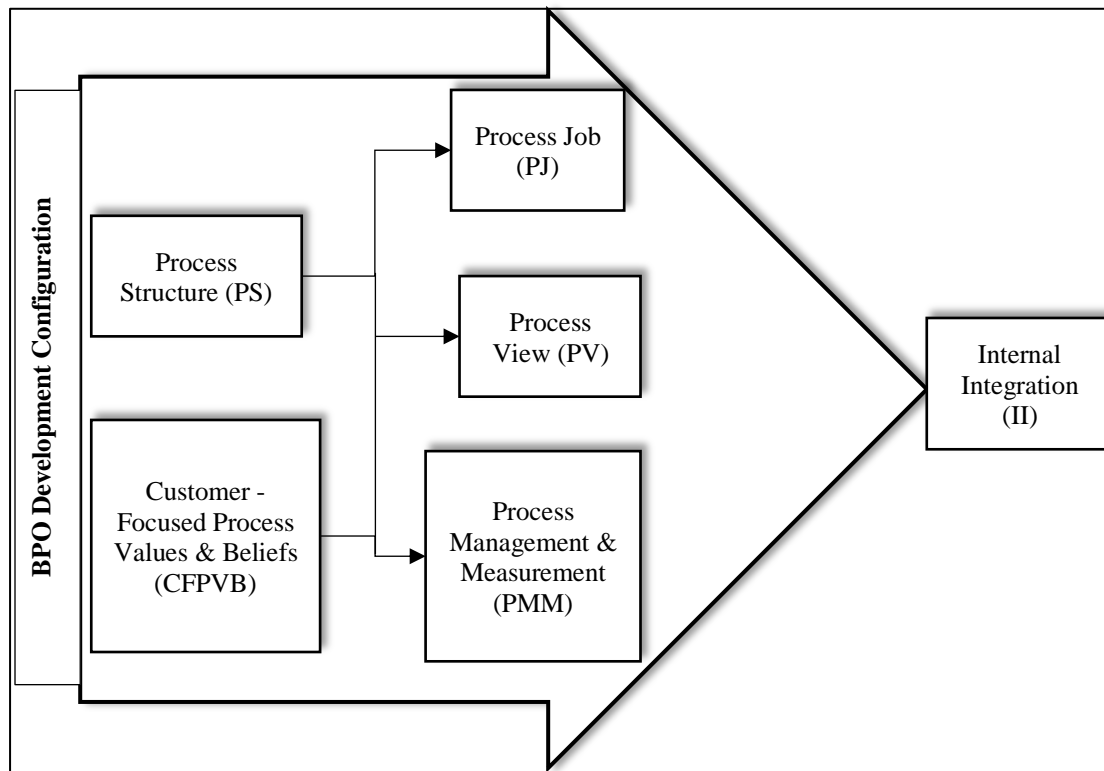


Figure 3.4. The Mediation Model

The analysis of the structure and culture aspects of process approach allows for a profound explanation of the systemic view in developing the Mediation Model, in which a structure and culture supportive of process approach are conceptualised as independent factors which influence other BPO practices, i.e. PJ, PV, PMM. In Chapter Two it was briefly argued that the supporting elements of BPO are deemed necessary for the basic elements to operate. This supporting view has been explicitly advocated in some past research (e.g. Paim et al., 2008, McCormack et al., 2009) and could also be seen implicitly in the work of some other scholars (e.g. McCormack and Johnson, 2001, Willaert et al., 2007). Developing a process-driven organisation has been reported as a far more difficult task in practice, and very few organisations, if any, has achieved a true level of BPO (Majchrzak and Wang, 1996, Vanhaverbeke and Torremans, 1999). This failure has been associated to underestimating the key role of both organisational structure (Vanhaverbeke and Torremans, 1999) as well as culture (Tenner and DeToro, 2013) which support process-oriented makeovers. In a case study conducted within the domain of BPM, Buck (2018) identifies both culture and structure aspects, such as functional organisation, top down hierarchy, resistance to change etc., as some of the main problems inhibiting a successful BPM initiatives. In support of this, Aparecida da Silva et al. (2012) also argue that migration from a functional to a process-oriented

organisation requires a structure that supports this transition, thus it would be challenging if an organisation does not break through functional barriers/structure. Firms in this situation have low capacity for cross-functional coordination (Aparecida da Silva et al., 2012). Hence, organisations need to prepare the required basis for the basic elements of BPO to work proactively (Paim et al., 2008, McCormack et al., 2009).

It is argued that simply re-defining business processes would not suffice to guarantee improved performance (Majchrzak and Wang, 1996). Elzinga et al. (1995) propose a six-stage methodology for process management and suggest that firms need to begin the process by first designing their organisations structure at the preparation stage. In this line of reasoning, it is also contended that firms require to commit to deconstructing their existing functional structure in an attempt to remove the prevailing hierarchical mode of management in order to identify core processes spanning several organisational units (Vanhaverbeke and Torremans, 1999). Empirical evidence has shown that without an appropriate organisational structure that provides the ground for organisational change, firms attempt could result in failure (Kohlbacher, 2010). In fact, in practice process approach efforts have been observed to begin the makeover before addressing the need for “organisational development and individuals behavioural change” (Davenport, 1993, p.162). In particular, Willaert et al. (2007, p.7) indicated that “in order to make process documentation [...] useful, organisations have to adapt their structure to their process view”. McCormack and Johnson (2001) noted that, in practice, process ownership could be strenuous as each functional authority involving in the business process takes ownership within their defined boundaries. This could result in conflict between the involved functional authorities if a process structure is not in place (McCormack et al., 2009) and as such compromise the effectiveness of a process owner role. Moreover, as for a process measurement system, McCormack et al. (2009) argue that PMM is not a panacea and must be supported by other dimensions. So, the development of a process measurement system without a process structure is thought insufficient to enhance process performance (Willaert et al., 2007). These argumentations are consistent with the systemic approach to BPM initiatives and reflect the very problem of linear cause-effect relationships existing in the reductionist stance. Indeed, such systemic perspective requires the structure element to be viewed as a leading variable to facilitate the development of a process approach by growing and reinforcing a process structure. Therefore, given that BPO is an important pillar for BPM adoption (Pradabwong et al., 2015) this view could be applied to the development of its underlying practices to investigate how their different arrangements could affect the behaviour and properties of BPO in stimulating and/or influencing II.

Research into BPM identifies that there is a complex interconnection between a process approach and culture capabilities supportive of its practices (Vom Brocke and Sinnl, 2011). Through the transition from functional to a process oriented management, managers

are suggested to take initiatives for cultural change, and develop a collective mindset among team members. Without building a collective culture, this change “will not go far enough to make employees feel collectively responsible for producing the outcomes required to satisfy customers” (Majchrzak and Wang, 1996, p.5). An empirical study on the relationship between corporate culture and process orientation by Kohlbacher (2011) suggests that cultural fit is a key issue to BPO projects (Hinterhuber, 1995). They emphasise that process orientation should be accompanied by a customer-focused culture reflected in people’s understanding to meet customers needs and the way they interact (Reijers, 2006, Willaert et al., 2007). Gullledge Jr and Sommer (2002) refer to the culture of information realignment and discuss that an embedded organisational culture is required in order to deliver the full benefits of business process management (BPM), otherwise the hierarchical mode of management may be reverted. Furthermore, “institutionalising process measures without the accompanying employee training will prove to be futile” (McCormack et al., 2009, p.804). “To define what to measure, people must understand the desired results and observe the general process in relation to customer satisfaction” (Aparecida da Silva et al., 2012, p.767). Bucher and Dinter (2008) also confirm that the development of a process-oriented approach takes the involvement of various stakeholders. For people to get involved, there needs to be an underlying culture (McCormack et al., 2009), promoting process terms and vocabularies (McCormack et al., 2009).

Several attempts have been made to conceptualise the notion of culture with the domain of BPM and its manifestation in process orientation practices. Drawing on their systematic literature review, Vom Brocke and Sinnl (2011) uncovered multiple relationships between culture and process orientation. Among the three main themes emerged from their literature review, culture was indicated to be either a dependent or an independent factor influencing BPM projects or represented as a *given phenomenon* (meaning the actual organisation culture that could either streamline or constrain BPM implementation) that contributes in success or failure of BPM techniques (Rosemann et al., 2004, Rosemann and Bruin, 2005, Schmiedel et al., 2019). Culture as an independent factor has been elaborated by several studies (Bandara et al., 2009). In this context, culture is recognised as a critical success factor which may both support or obstruct the BPM success. In other words, this perspective to culture asserts that “underlying values and beliefs as well as the institutionalisation of them in organisational structures and people’s actions play a role regarding organisational culture’s influence on BPM” (Vom Brocke and Sinnl, 2011, p.366).

Viewing culture as an independent factor, it has been widely theorised as a critical enabler in an organisational management change (Schein, 1990, Zairi, 1997, Abdul Rashid et al., 2004, Kavanagh and Ashkanasy, 2006) and business process management (BPM) (Llewellyn and Armistead, 2000, Spanyi, 2003, Hammer, 2015). The findings by Corrigan



(1996) contend that hierarchical structure and vertical communication are some of the culture barriers to BPM adoption. Cultural resistance is also identified as a main cause of BPM failure by the Forrester Group analysts (Savvas, 2005). This mainly arises from the lack of employees' understanding of process thinking and the necessity for process change (Vom Brocke and Sinnl, 2011). With this background, some past scholars conceptualised culture as the prerequisite of process orientation which consequently affects the outcome achieved through BPM and the value transferred to multiple areas of the business (Rosemann and Bruin, 2005). For example, Hribar and Mendling (2014) classify culture into four groups of clan, adhocracy, market and hierarchy and study the effect of the dominant organisational culture on BPO as a proxy for measuring BPM. They conclude that organisations with clan culture, which contains the core values of process-oriented approach, have the highest success impact on the level of BPM. In addition, hierarchy culture was revealed to be the least favourable culture type for the BPM development.

Informed upon the above views, this research suggests that culture is an independent factor that embraces values supporting BPO development. On that basis, it has a cause-and-effect relationship with the three basic elements given that literature has also frequently contends the supporting role of culture aspect of BPO. Consistent with the cause-and-effect relationship advocated by the systemic characteristics of BPM, the effect of culture has been suggested as an indirect mechanism by a few past scholars. For example, the theoretical model developed by Rosemann and Bruin (2005) suggests that culture has an indirect impact on business success through process orientation success.

Therefore, together the above arguments have led this research to propose the Mediation Model which represents an alternative composition of the BPO-II relationship. This model argues that the cause-and-effect relationships between the supporting and basic elements determines the behaviour of BPO, and as such influence its impact on II. As such, it is argued that the effect of the basic elements, i.e. PJ, PV and PMM, on II may be dependent on the state of organisational structure and culture. In other words, the three basic elements mediate the relationship between the supporting elements and II. Therefore, the following hypotheses are formulated:

***Hypothesis 2.a (H2.a +): "PJ mediates the positive effect of PS on II."***

***Hypothesis 2.b (H2.b +): "PV mediates the positive effect of PS on II."***

***Hypothesis 2.c (H2.c +): "PMM mediates the positive effect of PS on II."***

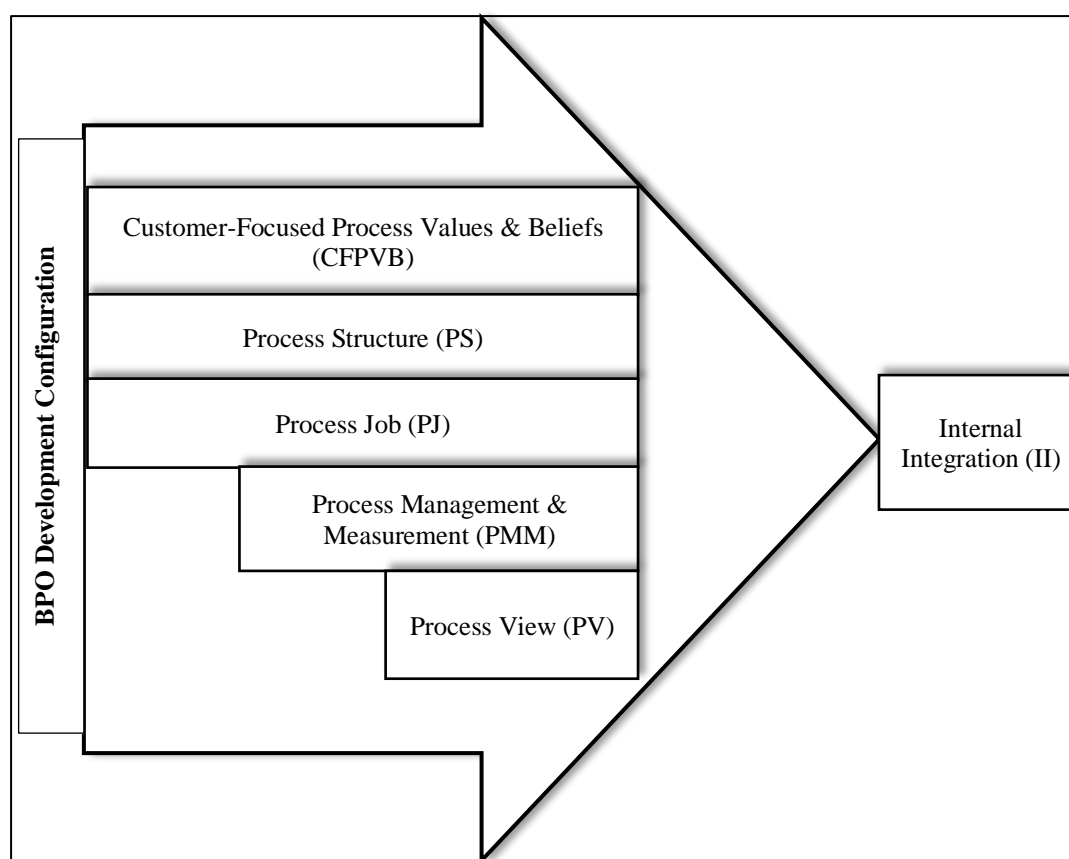
***Hypothesis 2.d (H2.d +): "PJ mediates the positive effect of CFPVB on II."***

***Hypothesis 2.e (H2.e +): "PV mediates the positive effect of CFPVB on II."***

***Hypothesis 2.f (H2.f +): "PMM mediates the positive effect of CFPVB on II."***

#### **3.3.4. The Hierarchical Model**

This section seeks to develop the third competing model (the Hierarchical Model) by further expanding the possible configuration of the BPO-II relationship through tapping into the concept of process maturity. In Chapter Two, the concept of Key Turning Points (KTPs) within BPO maturity model was briefly reviewed, and it was discussed that as organisations progress through their “process maturity, institutionalisation take place via policies, standards, and organisational structures” (Lockamy III et al., 2008, p.15). It was argued that there are several key factors contributing to moving across BPO process maturity path. To warrant BPO maturity several steps should be taken. This involves developing and stabilising certain practices at each level in order to provide the basis for adopting other elements. While past scholars have demonstrated that a higher level of BPO could result in increased supply chain collaboration (SCC) (Pradabwong et al., 2017), moving from one point to another across BPO maturity continuum needs the development of the right practices, and sometimes a combination of multiple dimensions should be established (McCormack et al., 2009, Vlahovic et al., 2010, Glavan, 2014, Glavan et al., 2015). Therefore, this research argues that the hierarchical development of BPO dimensions may serve a more effective underlying basis to achieve II, and as such the third competing model (Hierarchical Model) is proposed in Figure 3.5. It must be noted that at each stage the turning point dimension may need to be accompanied by different aspects of the preceding turning point, yet the proposed model only depicts the leading factor at each level for the sake of facilitating model development and analysis (see McCormack et al. (2009)).



*Figure 3.5. The Hierarchical Model*

At the heart of process maturity are several KTPs which facilitate these transitions. They constitute “important baseline for planning and implementation of SCM improvement efforts” (McCormack et al., 2009, p.796). PJ is broadly recognised to form the first key initiative in advancing on process maturity model towards a fully integrated SC (e.g. McCormack et al., 2009, Vlahovic et al., 2010b, Vlahovic et al., 2010a, Glavan, 2014, Glavan et al., 2015). For example, Vlahovic et al. (2010) argue that supportive managers per se is not a sufficient factor to reach BPO maturity level, yet a certain level of management commitment is required to start the journey. In addition, in identifying critical practices in BPO, Trkman (2013) recognised the importance of assigning process owners, suggesting that an exclusive focus on process organisation could not yield any major gains without removing unnecessary hierarchical approvals. In support of this, Willaert et al. (2007, p.7&8) argue that “measuring process outcome is not sufficient if no one is held responsible for it”. Thus, an assigned process owner should take responsibility for process outcome which directly influences customers’ needs. Additionally, building a cultural foundation and organisation structure that support these practices “enables process maturity to survive” (McCormack et al., 2009, p.794).

Therefore, this research draws on contingency theory (CT) and propose that the effect of BPO on II is contingent on the hierarchical development of its elements. Particlylarly, it is

then argued that the hierarchical development of PJ and PMM, respectively, could provide a dynamic basis which would make it possible to achieve an effective II. Thus, it is hypothesised that:

***Hypothesis 3.a (H3.a +): “PMM has a positive effect on the level of II, given that PJ is already developed.”***

The development of PJ and PMM should be followed by PV to move an organisation to the next level across the maturity path (McCormack et al., 2009). Identified as a critical factor, a case study by Trkman (2013) noted that defining and documenting process roles and responsibilities is one of the key determinant of BPO improvement. In support of this, Lee and Dale (1998) pointed out the key steps of process understanding, process documentation and the definition of cross-functional processes, and contended that these are essentials “to move on to the next stage of breakthrough and continuous improvement” in BPM (p.224). It is, though, argued that companies relying solely on defining and documenting processes have limited capabilities to advance along BPO maturity path (McCormack et al., 2009). In that sense, Kueng (2000) argues that PV should be supported by a holistic measurement system focusing on quantifying process performance. This provides a tool for a process owner/manager to gauge their key business process performance, and as such assess their business position compared to competitors. While, it contributes significantly to maturity resting on defined process measures (McCormack et al., 2009), to reach the next maturity level people participation and understanding of horizontal responsibilities must be emphasised. This takes the management commitment to promote an extensive usage of process language such as process owners, input, output, etc., which reflect an already established process culture (Willaert et al., 2007, McCormack et al., 2009). It is, therefore, hypothesised that:

***Hypothesis 3.b (H3.b +): “PV has a positive effect on the level of II, given that PJ and PMM are already developed, respectively.”***

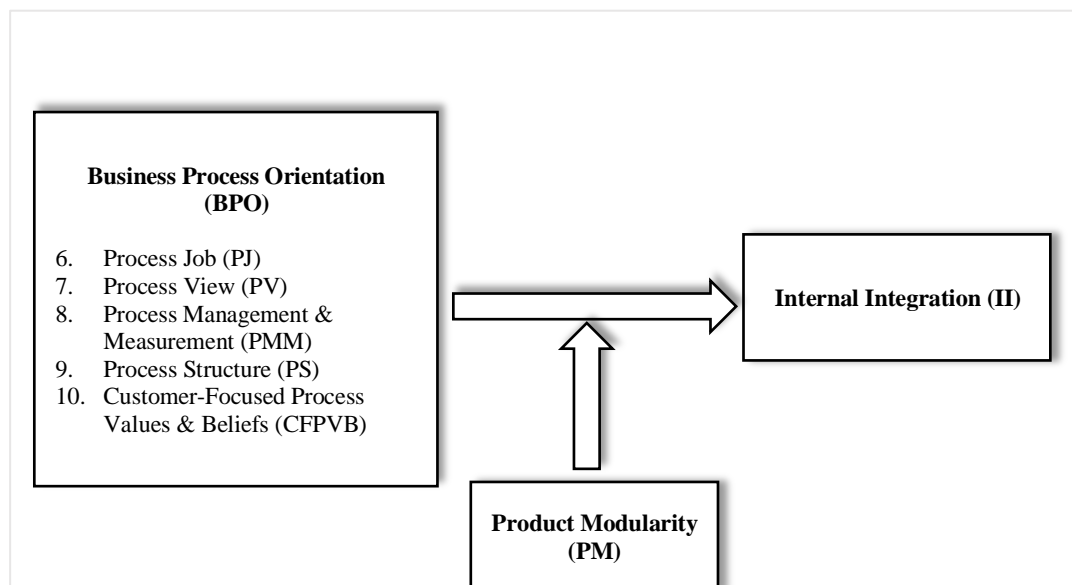
### **3.4.The Moderation Effect of Product Modularity (PM) on the BPO-II Relationship**

Within the context of supply chain management (SCM), it is extensively argued that decision about key business processes are not independent of product architecture characteristics, such as complexity of individual components, the degree of coupling between components, etc. (Gomes and Dahab, 2010). In this vein, literature has long addressed the fit between product characteristics and supply chain design structure (Coase, 1937, Williamson, 1985, Fine, 1998). Fisher (1997) argued that to fulfil customer requirements effectively supply chain structure and manufacturing process must be aligned to support product characteristics. This alignment has been conceptualised in terms of strategy-structure fit and examined broadly by early scholars who have reinforced the need for strategy, structure and production technology alignment (Suarez et al., 1995, Schroeder et al., 1995). Findings from Woodward (1965) showed that firms with aligned process and structure are more likely to outperform those who dismiss the significance of such alignment. Therefore, the present research argues that the body of knowledge emphasising the linkages among product characteristics and supply chain design is too substantial to disregard, given that the research gap identified earlier confirms further examination is needed in this area.

The current state of research pertaining to the relationship between product architecture and organisational design/the value chain structure has been misleading with a lack of consensus on the mirroring effect (Antonio et al., 2007). Literature review revealed that the mirroring hypothesis which is based on the assumption that modular product architecture results in a modular organisational structure does not always hold true (Brusoni and Prencipe, 2001, Hoetker, 2006). In this context, the seminal study by Sanchez and Mahoney (1996) on the effect of PM on organisational modularity has long generated interests in the implications of product architecture for organisational design at an intra-firm level. This has resulted in a growing body of knowledge (Colfer, 2007), suggesting that product architecture should support its organisational structure (Sorkun and Furlan, 2017, MacCormack et al., 2012). While a few recent researchers have come to take a contingent view on this relationship, arguing that the mirroring hypothesis is held true under certain conditions (Cabigiosu and Camuffo, 2012), such as “complexity of product architecture”, “capability dispersion along the supply chain”, etc. (Sorkun and Furlan, 2017, p.219), others asserted that modular product development generally promotes a modular organisation to support its activities, thus could result in centralising the focus of an organisation on its module/functional teams (Colfer, 2007).

Despite these discrete views, the present research is built on the theoretical basis proposed by the second group of scholars. As such our argument follows that of Colfer and

Baldwin (2016, p.710) who “argue that the mirroring of technical dependencies and organisational ties is an approach to organisational problem-solving that conserves scarce cognitive resources”. This indicates that in modular product development technical dependencies are sparse across modules, so reducing the need for intensive organisational ties, such as employment relations, communication channel and co-location. Whereas, these organisational ties are heightened within modules due to the presence of dense technical dependencies (Baldwin and Clark, 2000). In addition, perceived as the key principle of contingency theory (CT), firms tend to align their organisational structure with their product architecture (Henderson and Clark, 1990, Von Hippel, 1990, Chesbrough and Teece, 1996, Sanchez and Mahoney, 1996, Baldwin and Clark, 2000). Furthermore, as noted by Vickery et al. (2016) high product complexity, characterised by high modularity and large number of modules/parts, engenders the interdependency between product and process design decisions. Taken together, this research argues that the relationship between a process-oriented approach and internal integration (II) could be affected as a result of high PM, see Figure 3.6.



*Figure 3.6. The Moderation Effect of Product Modularity (PM) on the BPO-II Relationship*

According to Doran (2003) modular product development entails re-structuring the value creation activities due to “the potential complications stemming from interdependencies between processes” (Gomes and Dahab, 2010, p.61). Perceived as having second-order effects (Sanchez, 1995, 1998, Garud and Kumaraswamy, 1995), modularity is expected to enable distributed and parallel business processes “by separating component-level and architectural learning processes” (Worren et al., 2002, p.1124). Such effects will lessen a firm’s need to tightly-coupled organisational structure and free it to pursue the advantage of standardised module interfaces. Although these may make the use of modular architecture more common

and offer a range of flexibilities in product development, the consequences of PM for the value chain should not be underestimated (Fixon, 2005). The key challenges that have been brought to attention by several scholars in this regard are the implications of PM for an organisation's internal structure and communication pattern (Colfer, 2007).

A modular product design approach could potentially constraint an organisation to align its internal structure with its product development processes (Schilling, 2000; Baldwin and Clark, 2000). The basic assumption is that creating modular platforms results in three forms of architecture, including product, process and knowledge. For instance, it is argued that although the development of modular architectures could help "coordinate and accelerate distributed learning processes within supply networks", knowledge boundaries are evolved due to task decomposition (Gomes and Dahab, 2010, p.62). Indeed, PM could lead to knowledge and technical capabilities separation across business units, resulting in cross-boundary breakdowns (Staudenmayer et al., 2005, Langlois, 2006, Gomes and Dahab, 2010). In addition, firms adopting PM tend to reap the benefits of loosely coupled organisational structure, giving each function/unit/team the flexibility for more autonomous activities (Sanchez and Collins, 2001, Gomes and Dahab, 2010). Similarly, Shamsuzzoha (2011) argues that PM success comes at the cost of the formation of modular production process and team structure allowing easy reconfiguration of working units to meet multiple products functionalities. It is then contended that as the level of modularity changes the structure of communication varies, thus may affect the need and tendency for cooperative activities (Mikkola, 2007) due to decentralisation occurs across business processes (Colfer, 2007).

This situation could prompt further challenges in a highly complex environment due to some reasons. Complexity involved in product as well as process interdependencies in such environments requires a flexible network of communication across organisational entities to quickly adjust to unexpected failures throughout the processes (Colfer, 2007) and also compensate for knowledge asymmetry (Vickery et al., 2016). In addition, in complex and dynamic environments the lack of geographical and cultural proximity across functions/units could make the issue of decoupling worse (Lau and Yam, 2005, Howard and Squire, 2007). Complexity involved in some modular architecture may create unexpected parts interdependencies, failing a company to identify and navigate the required communication and interaction structure (Gokpinar et al., 2010). On that account, Gomes and Dahab (2010, p.62) suggested that "firms need to manage process interdependencies even in the presence of modular product architecture", especially in the case of high PM. Lau et al. (2010a) found that firms involved in the manufacture of complex products need to complement their modular approach with other organisational coordination skills and ability.

It is argued that although individuals are potentially willing to coordinate due to the nature of modular product development, they are restricted cognitively for cooperation due to

the unintended asymmetry of knowledge (Colfer, 2007). This indicates that the coordination element essentially exists among individuals due to the nature of works, but the cooperation, which is concerned with individuals attitude, needs some degree of cognitive freedom and empowerment (Colfer, 2007). With this in mind, Colfer argues that “when there are many complex interdependencies among the components of a product a change in one component will often necessitate many compensating changes in other components” (Colfer, 2007, p.7). Failure to account for this issue could become problematic for effective communication. To avert this problem, firms need to address the close relationship between the product architecture and organisation’s communication structure.

According to these perspectives, PM attributes are thought to influence the extent to which process orientation predominates. This, in turn, may dictate the mechanisms employees use to maximise effective communication and information exchange. As such, a modular product development could be in counter with a process-oriented mode of organisation (Sanchez and Mahoney, 1996, Hoetker, 2006). Anchored in these argument, this research argues that the association between BPO and II may be contingent on level of PM, and it may have a negative moderation effect on the BPO-II relationship. Therefore, the following hypotheses are formulated:

**Hypothesis 4.a (H4.a -):** *“The effect of process job (PJ) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

**Hypothesis 4.b (H4.b -):** *“The effect of process view (PV) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

**Hypothesis 4.c (H4.c -):** *“The effect of process management & measurement (PMM) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

**Hypothesis 4.d (H4.d -):** *“The effect of process structure (PS) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

**Hypothesis 4.e (H4.e -):** *“The effect of customer-focused process values and beliefs (CFPVB) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*



### **3.5.Summary of the Chapter**

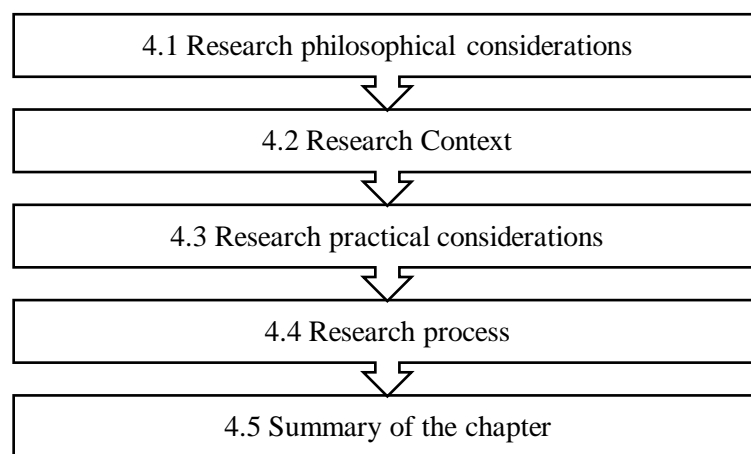
This chapter sought to provide an overview of the use of contingency theory (CT) in operations management (OM) research and discussed the logic behind taking a contingency view to develop the research theoretical framework in order to address the research questions. Given the preliminary nature of this research, the chapter presented three competing models informed by the literature in order to identify the most well-established relationship between BPO and II. This was followed by proposing a series of hypotheses on their parallel, mediating and hierarchical relationship. In addition, the chapter pointed out the implications of product architecture for organisational design, and explained how the BPO-II association could be contingent on the level of product modularity (PM). Thereby, a model investigating the moderation effect of PM on their relationship was developed, focusing on the mirroring hypothesis. The chapter was completed by developing the moderation hypotheses.

The following chapter provides an insight into the research philosophical and methodological standpoint through which the research questions will be examined.

## Chapter Four: Research Methodology

### 4. Introduction

The preceding chapter presented the research theoretical framework informed by the related literature. Based on the framework a number of hypotheses were proposed on the direct and indirect relationships between business process orientation (BPO) and internal integration (II). This was followed by some further hypotheses proposed for the moderation effect of modularity on the BPO-II relationships. This chapter aims to present the transformation process from a theoretical understanding into an applicable research methodology adopted to examine the proposed relationships. Figure 4.1 briefly presents the structure of this chapter.



*Figure 4.1. Summary of Chapter Four Structure*

#### 4.1. Research Philosophical Considerations (Research Paradigms)

Research paradigm is described as a belief system which guides researchers in understanding and interpreting a research phenomenon (Saunders et al., 2012). It is a framework which provides the lead on how research should be carried out, considering different perspectives and beliefs held by people regarding the nature of reality and knowledge (Collis and Hussey, 2013). The way to carry out a research to understand a social phenomenon is initially influenced by a research paradigm which comprises four philosophical dimensions, i.e. ontology, epistemology, axiology, and methodology (Wahyuni, 2012).

##### 4.1.1. Research Philosophies: Ontology and Epistemology

The primary step in research design is to identify the position on ontology and epistemology. Ontology refers to “the nature of reality” (Saunders et al., 2012, p.130) and concerns “claims and assumptions that are made about the nature of social reality, claims about what exists, what it looks like, what units make it up and how these units interact with each other” (Blaikie, 2000, p.8). Epistemology is concerned with “the theory of knowledge”

and how knowledge is being developed and perceived by different individuals who have different “ways of enquiring into the nature of the world” (Easterby-Smith et al., 2015, p.46). Research limitations and methods employed for enquiring into phenomenon and also research process are influenced by both ontological and epistemological philosophies (Edwards et al., 2014). For social scientists to conduct a research it is a preliminary step to draw on various ontological and epistemological assumptions which will influence the techniques and methods they adopt in their research (Easterby-Smith et al., 2015).

### ***Ontology (Realism/Relativism/Nominalism)***

For social sciences Easterby-Smith et al. (2015) introduce four ontological assumptions associated with three positions including internal realism, relativism and nominalism. Internal realism assumes that a social phenomenon and its consequence exist apart from the topic of enquiry and also what a researcher desires. Relativism refers to the position in which it is believed that the truth about social sciences differs among different individuals, so there are different viewpoints on a social phenomenon, forming distinctive realities. Nominalism concerns an ontological stance advocating the social phenomenon or experiences and postulates that there is not an absolute truth about the reality and different forms of realities are constructed by human creations who attach particular names and terms to events (Easterby-Smith et al., 2015, Bell et al., 2018).

### ***Epistemology (Positivism/Interpretivism/Critical Realism)***

Within the context of business and management discipline, three main research philosophies/theoretical perspectives are presented, i.e. positivism, interpretivism and critical realism. Positivism is defined as a philosophical position which accepts the existence of social world as being external and objective rather than being constructed subjectively (Saunders et al., 2012, Easterby-Smith et al., 2015). Interpretivism is concerned with constructing meaning by people in a given situation and the way they understand social occurrences. Social actors (humans) lie at the heart of this approach based on which a researcher seeks to study a given social phenomenon (Lewis-Beck et al., 2003, Saunders et al., 2012). Finally, critical realism assumes that social world exists (Edwards et al., 2014) and has its consequences independent of being observed or perceived by individuals (objective reality) (Easterby-Smith et al., 2015). “It also recognises that part of that world consists of subjective interpretations which influence the ways in which it is perceived and experienced” (Edwards et al., 2014, p. 2 & 3).

### ***Rationale for Adopting a Critical Realist Approach in This Research***

The focus of this research is to examine three competing models and identify the best model explaining the relationship between BPO and II. It seeks to further assess the

moderation effect of product modularity (PM) on this relationship. In line with the context-dependent nature of BPO and II (Ravesteyn, 2009, Turkulainen and Ketokivi, 2012, Vom Brocke et al., 2016) this research adopts a critical realist position to identify the aforementioned causal relationships. A critical realist position is an alternative to positivism and interpretivism, and as discussed earlier is grounded on the idea that there is an external reality independent of it being observable, and science can investigate it (Bhaskar, 1978). Unlike positivism, critical realism does not believe that the ultimate goal is to discover regularities and generalise them. It neither holds the opinion of an interpretivist who believes in the social world that is socially constructed (Jones, 2010). Therefore, taking a critical realist perspective in this research, it is presumed that the theoretical framework could be scientifically examined in order to explore the proposed relationships, while believing in the existence of an external reality irrespective of it being observable.

Theory-testing of social phenomena has become difficult because of the complexities associated with organisations and human behaviours constituting the social world (Miller and Tsang, 2011). It is argued that, in the light of empirical methods which are advanced in identifying the relationship between different phenomena in the field of operations management (OM) and supply chain management (SCM) (Rotaru et al., 2014) further research could enhance the understanding of these phenomena if the social structure tied between individuals and their environments are considered (Mingers, 2004). The fact that in a social world social actors behaviours can impact social conditions (empirical studies) suggests that empirical investigations are less controlled than experimental studies in which different factors can be managed (Easterby-Smith et al., 2015). This clearly indicates the distinction made by the critical realist position between natural and social world as it assumes that the social world is created by social actors who continuously change their behaviour. While there has been an ongoing controversy around the explanatory power of statistical techniques in critical realist approach (e.g. Archer, 1998), an emerging school of thought has advocated the application of these techniques in drawing causal conclusions (e.g. Ashkenas et al., 2002, Pratschke, 2003, Næss, 2004). This is, though, conditional upon satisfying the assumption that a well-specified model has been developed which could, then, result in estimating valid causal relationships. In fact, one must ensure the inclusion of the most important and relevant factors into the model prior to statistical analysis (Pratschke, 2003). This assumption was satisfied by conducting an extensive literature review led this research to establish a theoretical account of the underlying mechanisms of the relationship between BPO, II and PM.

In critiquing the adoption of a pure positivist approach, some researchers contend that it ignores the time and context in which the social interactions occurred in favour of outcome generalisation (Nagel, 1989, Johnson and Onwuegbuzie, 2004) which is against with the context-dependent nature of the constructs under this research. In developing the theoretical

framework this research adopts latent variables (i.e. BPO, II, and PM) which are influenced by social aspects of a business environment. Literature review revealed that different studies adopted a diverse set of measures to conceptualise these variables depending on their specific research context. In the state of such diverse measurement systems, taking a positivist approach would not be appropriate (Saunders et al., 2012). It is therefore argued that, the philosophical approach selected in this research must render some degree of flexibility to consider the context-specific quality of the concepts under observation.

An alternative to a positivist standpoint is an interpretivist approach which is not also considered to be in favour of the objectives of this research. An interpretivist emphasises the importance of the reality being socially constructed by individuals (Lewis-Beck et al., 2003, Saunders et al., 2012). Although, human is seen as a central element to this philosophical approach (McGregor and Murnane, 2010), scholars associate a number of criticisms to it. For example Coleman and Briggs (2002) put forward some key shortcomings of this approach as follows:

(1): There are multiple realities constructed by different people in a given situation and the way they understand social occurrences, so reality cannot be obtained as it is perceived differently from different perspectives;

(2): Humans tend to reflect on their behaviour in an unstructured manner since their behaviours involve in a regular and routine procedure.

The above could occur due to the lack of humans' ability to comprehend and interpret their owns or others' behaviours as well as the social incidents. Given the unique context associated to each business setting, the adoption of such approach would also make the data collection process enormously challenging due to the amount of time and cost involved in conducting, for example, in-depth case studies. Therefore, this research advocates a critical realism position over positivism and interpretivism which do not hold the right view in answering the research questions. The viewpoint provided by critical realism will allow this research to distinguish between social entities, which are human actors and organisations (social context) in this research study, thus this would make it an ideal philosophical stance among all other approaches which lack in supporting the objective of this research.

#### **4.1.2. Axiology (Ethics) and Methodology**

Axiology or ethics is concerned with how the role of values is being perceived and viewed by a researcher. For a research results to be credible, this aspect of research process needs to be taken into account throughout the research process (Lincoln et al., 2011, Saunders et al., 2012). Axiological considerations and skills provide the basis for a researcher to make judgment, based on their values, about different phenomena that appear and are experienced in a study (Saunders et al., 2012). Methodology is an indispensable and critical stage of every

research established in order to identify and analyse information about a certain phenomenon (Crotty, 1998, Lincoln et al., 2011). In particular, it refers to the means by which knowledge is gained and justified, and more specifically the logics behind the choices of techniques, research strategies for theory development and data analysis, or in a more general term a project execution (Blaikie, 2000).

#### **4.1.3. Approaches and logics to Theory Testing**

There are four approaches to the research theory testing, i.e. *inductive*, *deductive*, *abductive*, and *retroductive*. An *inductive* approach allows theory development by initially undertaking data collection which is averse to a *deductive* approach in which a theory is derived from reviewing literature and data is collected to test and verify a developed theory. In other words, the former inductively explores a phenomenon under study to generate a theory, and the latter concerns theory verification or falsification. An *abductive* approach is a form of explanatory logic associated with the critical realism and resembles an *inductive* mode of inference, but essentially combines both approaches for generating a new theory to modify existing theories. In effect, it starts with data collection via observation and strives to understand the causal mechanisms explaining the observed events. It effectively seeks to reinterpret data which might arrive at a different conclusion than previous studies and lead to a new theoretical framework. *Retroductive* is another form of reasoning pertaining to the critical realism position and strives to identify specific circumstances in which mechanisms are happening as they are observed (Saunders et al., 2009, Edwards et al., 2014).

##### ***Deductive Approach as the Adopted Research Logic***

As it was mentioned earlier, deductive logic to theory testing takes a more objective approach in measuring concepts and phenomena under study, as oppose to a subjective (or more qualitative) interpretation (Crotty, 1998). This approach mainly emphasises on recognising the causal relationship between variables which entails the process of developing, testing and verifying hypotheses (Collis and Hussey, 2013). As such, the five following trends are identified for conducting a deductive research as (Creswell, 1994, Gay et al., 2008, Yilmaz, 2013): (1) proposing hypotheses informed by strong theoretical foundation based on literature review; (2) defining a measurement model representing the association between constructs; (3) examining the proposed relationships; (4) analysing and drawing conclusion; and (5) modifying the theoretical framework based on the findings. A key characteristic of this type of data collection method is its well-structured approach in generating numerical data used to analyse pre-developed hypotheses (Bell and Bryman, 2007). A deductive reasoning is argued to be most suitable in situations where a researcher seeks to draw a true conclusion if the premises are true (Johnson and Christensen, 2008). Thus, one needs to ensure about the

assumption being true and based on concrete arguments in order to arrive at a valid conclusion (Johnson and Christensen, 2008). Moreover, a deductive approach mainly involves theory verification process in which hypotheses deductively developed are examined through analytical methods (Punch, 2013). The use of a deductive critical realism approach allows for an objective investigation of the relationship between BPO, II and PM. Such approach adopted by some past researchers (e.g. Boyd, 1983, Muncy and Fisk, 1987, Ebrahimi, 2015) alleviates the complexity involved in casual relationships studies (Perren and Ram, 2004). This is counter to a subjective approach which is believed to exert more challenges in investigating these relationships. In fact, taking a subjective approach is subject to the social actors subjective interpretation of the phenomena (Saunders et al., 2012), and as such may not provide the true representation of the relationships under study. Therefore, given the inherent complexities in high- and medium-tech manufacturing firms (which is the context of this research and will be explained later) the objective approach provides a better opportunity for making a theoretical contribution.

#### **4.1.4. Field Research Development Stages**

Business practices, e.g. BPO, BPM, SCI, etc., in the field of OM have stimulated an increased collaboration between researchers and practitioners for the development of a ground theoretical language which helps to make sense of data generated empirically and create knowledge (Karlsson, 2016). Knowledge creation is the primary goal of a research without which “empirical research merely becomes ‘data-dredging’” (Handfield and Melnyk, 1998, p.321). Scholars approach knowledge creation by identifying the need for developing a novel theory, or extending an already existing theory to incorporate some new aspects of a research field. And in some cases existing theories are repudiated as they no longer “are [...] able to withstand the scrutiny of empirical research” (Handfield and Melnyk, 1998, p.321). Choosing an appropriate methodological approach is driven by the maturity of the field of research. In order to determine the research approach which best fits with a research question the state of current theory should be investigated through reviewing the literature and informing methodological decisions accordingly (Edmondson and McManus, 2007).

Through a rigorous exploration of a field research one is able to choose the most suitable methodological fit with research question. Edmondson and McManus (2007) draw on various academic sources proposing a framework on how to produce a methodological fit with the state of a current theory which will consequently result in a fit between the methodology and research question. It is only when a research question could be effectively investigated that a researcher builds a constructive methodological approach in a systematic way. They propose three archetypes, (i.e. Nascent, Intermediate, and Mature), of methodological fits in

field research, see Table 4.1. Decision on what development stage the current research fits in is drawn from understanding of the prior works.

*Table 4.1. Three Archetypes Methodological Fit, Adapted From Edmondson and McManus (2007)*

<b>State of prior theory and research</b>	<b>Nascent</b>	<b>Intermediate</b>	<b>Mature</b>
Type of data collected	Qualitative, open-ended mode of enquiry	Hybrid (both qualitative and quantitative)	Quantitative
Method of data collection	Interview: observation, obtaining documents from field sites	Interview: observation, survey, obtaining materials from field sites	Survey, interviews or observation designed to be systematically coded and quantified
Data analysis methods	Thematic content analysis coding for evidence of constructs	Content analysis, exploratory statistics, and preliminary tests	Statistical inference, standard statistical analyses

In a Nascent stage the field research lacks any existing theory and the type of research approach fits this stage is inductive. Intermediate stage refers to the state of the research where theory is derived from prior work, incorporating new measures and constructs which may result in developing new constructs coupled with a tentative theory. Intermediate research frequently incorporate quantitative as well as qualitative for constructing methodological triangulation. This helps to achieve construct and external validity for the developed measures. A Mature field research is a development stage where an extensive research has already been performed and rigorous theory has been developed, yet it still requires some “further refinements within a growing body of interrelated theories” (p.1159). At a Mature stage, existing theories might be adapted to a wide variety of contexts and situations.

This research seeks to verify the assumptions of the contingency theory as the key theoretical lens adopted in this research. It also aims to contribute in developing new knowledge, expanding on the already existing theories in the field of SCM, in particular internal integration (II). The scope of current research meets the criteria of an Intermediate stage, mentioned above, given the fact that the II field research is still developing and the field is within the scope of knowledge “but not enough is known to do so with numbers or at a safe distance from the phenomenon” (Edmondson and McManus, 2007, p.1166). Indeed, this research draws from the separate bodies of literature, i.e. SCM, OM, and BPM, to develop new ‘provisional theoretical relationships’, while using rich sources of pre-developed and validated measures within each body of knowledge. As already discussed in the previous chapter, to the best of our knowledge the existing SCM literature is not rich enough for the provision of a theoretical framework forming the underlying basis to cultivate the existing



integrative practice and develop II, and literature has mainly been suggestive than prescriptive. This has been partially attributed to the lack of a thorough understanding of the strategic role of II within an extended SC (Frankel and Mollenkopf, 2015), leading the research to mainly focus on external integration while replicating the pre-developed conceptualisations of II.

Furthermore, II has been frequently defined as practices employed by functions to work effectively as an 'integrated process' within an organisation (Flynn et al., 2010), but the elements of a process-oriented approach have not been investigated in its conceptualisation, despite a growing trend emerging in SCM research operationalising a process-oriented approach (e.g. Lindfors, 2001, McAdam and McCormack, 2001, Pagell, 2004, Power, 2005, Chen et al., 2009a, Lockstroem et al., 2010, Huo, 2012, Vallet-Bellmunt and Rivera-Torres, 2013, Leuschner et al., 2013, Eriksson, 2015b, Movahedi et al., 2016). This is believed to be the cause of inconsistent results in practice with regards to the implications of II for performance objectives. While, there is a broad and growing body of knowledge addressing the potential benefit of II and various definitions and conceptualisations have been assigned to it (e.g. Flynn et al., 2010, Horn et al., 2014), the literature still lacks a rigorous theory focusing on the means to achieve integration. Thus, it is situated at an Intermediate stage.

The suggested approach to investigate an intermediate theory study is hybrid (see table 4.1) to understand statistical relationships, through quantitative methods, as well as explaining what happens behind that relationship with the means of qualitative techniques. The use of either quantitative or qualitative exclusively is argued to suffer from poor fit, if for example new measures are used to quantitatively examine a relationship without "qualitative illustration and triangulation" (Edmondson and McManus, 2007, p.1172). However, since all the measures are adopted/adapted from the pre-developed and validated scales in the literature, the use of pure quantitative method would not jeopardise the credibility of the data and results. Therefore, this research solely rests on the arithmetic means of questionnaire to study the relationship between BPO, II and PM, which will also allow us to maintain the consistency between the research objectives and the predominant methodology in the management field (Edmondson and McManus, 2007).

## **4.2. Research Context: High- and Medium-Technology Manufacturing Sector in the UK**

### **4.2.1. The Definition of High- and Medium-Tech Companies**

Research has predominantly focused on the issues faced by high-technology sectors. According to the definition provided by The Organisation of Economic Co-operations and Development (OECD) manufacturing industries are classified into low-, medium- and high-technology sectors. This definition has long been used by many past scholars who further

broke it down into additional classifications, occasionally (OECD, 2006, Kirner et al., 2009). OECD has also divided industries based on their sectors into manufacturing and services (OECD, 2006). Table 4.2 adopted from Hatzichronoglou (1997) illustrates the classification of high-, medium-high-, medium-low- and low-tech industrial sectors, which has classified them into four categories. The average share of R&D expenditure is an indicator of the level of technology intensity of each industrial sector (Kirner et al., 2009).

*Table 4.2. Manufacturing Industries Classified Based on Their Global Technology Intensity (Hatzichronoglou, 1997)*

<b>High-technology</b>	<b>Medium-high-technology</b>
Aerospace Computer, office machinery Electronic-communications Pharmaceuticals	Scientific instruments Motor vehicles Electrical machinery Chemicals Other transport equipment Non-electrical machinery
<b>Medium-low-technology</b>	<b>Low-technology</b>
Rubber and plastic products Shipbuilding Other manufacturing Non-ferrous metals Non-metallic mineral products Fabricated metal products Petroleum refining Ferrous metals	Paper printing Textiles and clothing Food, beverages, and tobacco Wood and furniture

There has been an ongoing debate regarding this sectoral perspective which is addressed by Kirner et al. (2009). The implication of the sectoral perspective is an aggregate view on the intensity of R&D development which disregards the level of R&D intensity at a firm level. This approach has been criticised due to the lack of its potential to specify the level of technology intensity at the level of a single firm, and it does not consider the level of innovativeness which can be achieved by each individual firm regardless of the sector it is associated with. Given this inadequacy, Kirner et al. (2009) represent that the alignment between an industrial sector level of technology intensity and an individual firm is not always the case, and the right measure should classify firms into the three high-, medium- and low-tech sector, adopting the classification of OECD. Nevertheless, despite the importance of both industry and firm level technology intensity, this research will only draw on the industry level R&D expenditure. This is due to the confidential nature of firm-level expenditure, so most companies might not be willing to share this information. It could also affect their willingness to participate in the study, thus affecting the response rate.

To obtain the data on the UK high- and medium-tech manufacturing firms, this research used the FAME (Financial Analysis Made Easy) database which provides academic access to a large number of organisations in the UK and also the Irish firms key information such as, key person contact details, number of employees, annual turnovers, active and

dissolved firms, etc. The target population was obtained from the UK Standard Industrial Classification (SIC) 2007 of the manufacturing sectors based on their industry-level R&D expenditure which is also in line with the OECD categorisation of high- and medium-tech manufacturing sectors. These sectors are believed to be particularly suitable for the current research study because of their distinctive characteristic of producing high variety products. Literature has demonstrated that firms operating in these sectors are more likely to get involve in modular product development (Ulrich and Ellison, 1999, Salvador, 2007, Lau et al., 2010a). Empirical research also suggested that organisational coordination tends to be higher in firms with high level of PM (Lau et al., 2010b). In addition, PM has been the subject of study in a number past research conducted in high product variety sectors such as home appliances (Worren et al., 2002), electronics (Meyer and Roberts, 1986, Sako and Murray, 1999) and automobile (Fixson et al., 2005, Cabigiosu et al., 2013). Accordingly, the five manufacturing sectors presented in Table 4.3 were selected in this research.

*Table 4.3. The Five Selected High- and Medium-Tech UK Manufacturing Sectors by the Industry-Level R&D Expenditure (the UK SIC 2007 Classification) adopted from Business (n.d.)*

<b>Manufacturing Sectors</b>	<b>Industry-Level R&amp;D Expenditure in £ million</b>
Manufacture of computer, electronic and optical products	1,090
Manufacture of electrical equipment	175
Manufacture of machinery and equipment n.e.c.	831
Manufacture of motor vehicles, trailers and semi-trailers	2,948
Manufacture of other transport equipment	1,813

#### **4.2.2. The Fundamental Benefit of Internal Integration (II) to High- and Medium-Tech Firms**

The importance of II in high- and medium-tech industries has become apparent both in theory as well as among practitioners. The lack of integration and collaboration between business functions has widely been proven to hampering performance (e.g. Rodrigues et al., 2004, Gimenez and Ventura, 2005, Troy et al., 2008, Tang et al., 2013, Sweeney, 2013). In their meta-analysis in which high- and low-tech companies were compared Troy et al. (2008) identified that high-tech firms are more influenced by II due to the greater competition they face, the greater responsiveness they need to attain in order to adapt to the ever-growing technologies, and also the nature of their industrial products which is more likely to become obsolete after a certain period of time. Similarly, Dehning et al. (2007) also reported that high- and medium-tech firms investing more in R&D gain benefit from II through improved responsiveness and a greater access to advanced knowledge

The inherent uncertainty and instability in high- and medium-tech manufacturing firms have increasingly forced them to seek for a high level of II (Troy et al., 2008). While, low-tech firms in which environmental dynamism and volatility are not prevalent, II does not

appear to be a key source of success (Troy et al., 2008). In fact, environmental dynamics drive decision makers in high-tech firms to obtain relevant knowledge and expertise spread across several functions. This leads them to deal with a sheer amount of information which must be processed and turned into competitive advantage. Within the context of NPD, Song and Xie (2000) also suggested that due to the greater innovative activities involved in such business environments firms are in a greater need for leveraging cross-functional knowledge and information. Wong et al. (2011) also argue that in the presence of environmental uncertainty, product cost and quality are the factors that are most influenced by II. Some other notable impacts of II are indicated as its capability to eliminate functional barriers (Flynn et al., 2010) and a consistency between departmental goals (Deming and Edwards, 1982). Accordingly, cross-purpose work is avoided, resulting in a more effective use of resources (Pagell, 2004).

Empirical evidence shows that the complex nature of manufacturing processes in these firms reflected in their value chain interdependencies (Gallasch et al., 2004) could induce greater communication and interaction in order to provide a wide access to expertise and knowledge where employees lack required skills (see for example Gerwin, 1988, Collins et al., 1988, Baba, 1989, Souder and Padmanabhan, 1989, Tjosvold, 1990, Susman, 1990, Klein, 1991). In the absence of a well-established II, the functions at higher level might negatively affect those at lower level if the changes in the processes are not effectively communicated across the value system (Gallasch et al., 2004). In addition, while information sharing could happen cross-functionally, functions may continue to make decisions in isolation, creating a situation for sub-optimisation. Therefore, owing to the ever-growing technology and its associated complexities, the benefits of II are being recognised more broadly. As such, managers are more compelled in building integrative competencies than before (Hayes, 2002, Parker and Anderson, 2002, Williams et al., 2002, Rosenzweig et al., 2003, Bardhan and Pattnaik, 2016).

### **4.3.The Research Practical Considerations**

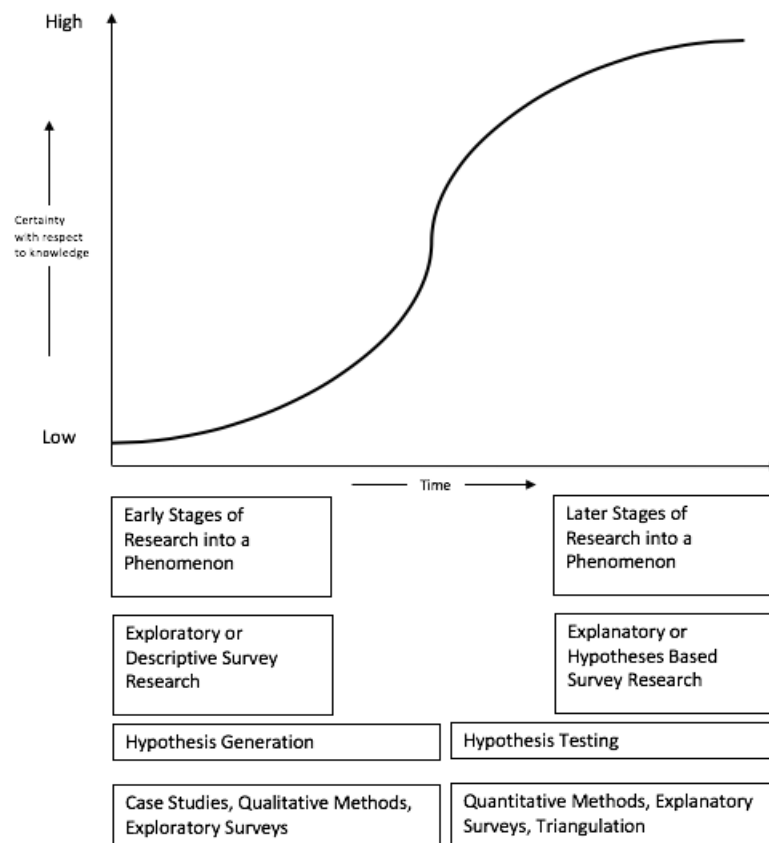
At the planning stage of any research there are a number of practical issues influencing the methodological decisions and should be considered by the researcher. These issues are concerned with the research strategy, data collection method and sampling strategy (Forza, 2002, Bell et al., 2015, Bryman, 2016). The significance and importance of each of these aspects are discussed in detail in the following sections.

#### **4.3.1. Research Strategy**

Research strategy guiding the direction of a research design procedure has a bearing on a more applied level of research (Creswell, 1994). With different research following

distinct purposes, including explanatory, exploratory and descriptive, research strategy may vary (Saunders et al., 2012, Nardi, 2018). These strategies are closely related and determine the logic of adopting a specific research approach such as inductive and deductive reasoning (Saunders et al., 2012). The current research solely draws on an explanatory strategy which will be discussed in the following.

**Explanatory research:** As a research takes the initial steps towards maturity, effective theoretical relationships between concepts/variables could be established using an explanatory mode of enquiry (i.e. survey) (Malhotra and Grover, 1998), see Figure 4.2. The main focus in explanatory research involved in theory testing is to explain the cause-and-effect relationships between variables under study (Malhotra and Grover, 1998, Saunders et al., 2012, Nardi, 2018). In other words, this type of research aims to explain why and how some relationships exists (Nardi, 2018) from theory-based point of view (Malhotra and Grover, 1998). Therefore, this approach entails testing pre-developed hypotheses investigating that if a relationship exists or identifying the direction of variables association (Malhotra and Grover, 1998).



*Figure 4.2. The Evolution of Research Adopted from Malhotra and Grover (1998)*

### ***Rationale for the Adoption of an Explanatory Research Strategy***

The primary objective of this research is to develop a theoretical framework representing the underlying basis of an effective II. It is also aimed to investigate how PM moderates this theoretical model. To achieve these objectives, it is sought to investigate the causal relationships between BPO, II and PM by testing their underlying hypotheses. Therefore, an explanatory study provides the most suitable approach which helps to understand and explain the aspect of these relationships. It also allows to adopt a quantitative research methodology, thus making it possible to conduct statistical analyses. On that account, neither exploratory nor descriptive strategies are appropriate approaches in this research study. An exploratory research is a flexible research strategy conducted when there is not sufficient information available to study a specific phenomenon (Sekaran and Bougie, 2016, Nardi, 2018). This strategy is employed for research investigating concepts which are at their early development stage, see Figure 4.2. In addition, a descriptive research is referred to as another type of exploratory research strategy (Malhotra and Grover, 1998). The objective of a descriptive research is “to portray an accurate profile of persons, events or situations” (Robson, 2002, p.59) and maybe an extension of a piece of exploratory or explanatory research (Saunders et al., 2012).

### **4.3.2. Data Collection Method**

#### **4.3.2.1. Survey Mode of Inquiry (Questionnaire)**

Research in the field of SCM and OM is primarily survey-based. Both descriptive and explanatory approaches have been widely used to describe a situation under review, and for theory testing, respectively, in the field of OM. Theory testing involves examining and substantiating the accuracy of some hypothesised relationships between different concepts, while also verifying the scope of the theoretical framework representing these relationships (Forza, 2002). “Survey is a systematic method for gathering information from [a sample of] entities for the purpose of constructing quantitative descriptors of the attributes of the larger population of which the entities are members” (Groves et al., 2011 p.2). Surveys can be executed in three forms of exploratory, explanatory or descriptive (Pinsonneault and Kraemer, 1993, Filippini, 1997, Malhotra and Grover, 1998).

Survey tends to be the primary data collection technique in deductive theory testing approach (Saunders et al., 2012) through which data is collected using mailed questionnaire, personal or telephone interview, etc. (Rossi et al., 2013). While questionnaire and interview are the two primary data collection techniques used to conduct a survey research (Forza, 2002), some researchers have suggested the use of questionnaire as more effective in a survey-based

research (Flynn et al., 1990, Snow and Thomas, 1994) through which existing patterns across a population could be established (Kendall, 2008, Harris and Brown, 2010). Different techniques are used to administer questionnaires such as mail, in person visit or telephone calls (Forza, 2002). Nevertheless, decisions on the most appropriate technique might be constrained by time, cost and resources. For instance, mailed questionnaire is cost- and time-effective, and could easily deal with the respondents' anonymity and interviewer bias issues (Forza, 2002). But, the lack of the researcher involvement, and longer waiting time to receive responses are some of its shortcomings. Table 4.4 summarises a comparison between the three forms of questionnaire administration, highlighting their relative advantages and shortcomings (Forza, 2002).

*Table 4.4. A Comparison of the Three Forms of Questionnaire Administration Adopted Forza (2002)*

<b>Factors influencing coverage and secured information</b>	<b>Mailed questionnaire</b>	<b>Personal interview</b>	<b>Telephone survey</b>
Lowest relative cost	1	3	2
Highest response rate	3	1	2
Highest accuracy of information	2	1	3
Largest sample coverage	3	1	3
Completeness, including sensitive materials	3	1	2
Overall reliability and validity	2	1	3
Time required to secure information	3	2	1
Ease of securing information	1	3	2

#### ***Rationale for the Adoption of Mailed Questionnaire Survey***

The use of a survey method is consistent with a contingency theory (CT) adopted in the present research (Sousa and Voss, 2008). Drawing on the main purpose of this research, data collection will take place, aiming at investigating the quality and competency of the hypothesised relationships in explaining the outcome variable (II) as well as the significance of 'validity boundary' of the theoretical framework (Forza, 2002). This research conducts an explanatory survey in an attempt to test the pre-developed framework as well as incorporating descriptive statistics on the target population. This is also in favour of the critical realist approach which allows this research to distinguish between social entities, i.e. human actors and organisations (social context), in this study (Hurrell, 2014). The key driving force for adopting survey is to examine to what extent BPO provides the underlying basis of II. It also allows this research to test the moderation effect of product modularity on the BPO-II relationship. Drawing on Table 4.4, the mailed questionnaire is the most cost effective method of data gathering and entails the second highest reliability and validity, and data accuracy among the other two forms of questionnaire. In addition, respondents confidentiality, which is a fundamental aspect of the target population, is best facilitated through mailed questionnaire. Moreover, the mailed questionnaire is used to be able to effectively manage

data gathering procedure as it is suggested to be a more convenient and an undemanding method of communication and interaction with participants locating in distant locations (Göritz and Crutzen, 2012). It is further argued that if executed properly, survey research could be replicated and generalised to other business settings.

However, surveys present some limitations such as biased sample, relatively low response rate, and limited accessibility to target population as well as relevant participants who have the required knowledge. It is suggested that these constraints could be minimised through focusing on a series of planning activities such as time horizon, sampling technique, sample size, pilot study, measurement instrument, and questionnaire reliability and validity (Forza, 2002). The following sections will discuss these aspects in detail.

### ***Time Horizon (Cross-Sectional Research Design)***

Time scale is a key practical consideration which is incorporated in the research strategy differently. Depending on the main objectives of a research and its associated research questions time horizon could either be cross-sectional or longitudinal (Bryman, 2016). A cross-sectional design collects data to make inferences about a population of interest at one point in time (Lavrakas, 2008). While a longitudinal research is conducted to collect data about the same subject at multiple points of time. The use of a longitudinal research design is seldom in social research due to its cost and time implications (Bryman, 2016). Like any other academic research, this research is restricted to a time frame that does not allow to conduct a longitudinal study (Saunders et al., 2012). Although it could potentially provide the opportunity to study the changes and development of BPO, II and PM within the target companies, this is not the main purpose of this research. Indeed, this research seeks to study these concepts in an attempt to examine their relationships at the present moment. Therefore, cross-sectional research is the most appropriate approach for the current research.

### ***Sampling Technique***

The process of sampling in survey research involves providing information about a target population with some degree of accuracy (Boer). This entails choosing appropriate events, or participants that fit well with the objective of a research (Rea and Parker, 2014). To ease this process sampling techniques are used which help an effective and efficient data collection from a snapshot of the population (Saunders et al., 2012). Probability and non-probability sampling are generally used in social research as the sampling techniques. Probability sampling procedure is mainly followed in quantitative studies in which samples are selected with equal opportunity in a given population. Using the responses from these samples, statistical inferences could be drawn about the target population (Robson, 2002, Bell et al., 2015). However, this technique is rarely appropriate for qualitative studies in which



researchers tend to apply non-probability method. In contrast with probability sampling this technique is not randomised and samples are selected based on their accessibility or appropriateness to meet certain criteria established by a researcher. Thus, the two techniques are distinguished by their representativeness allowing for generalising findings. While a probability sampling technique primarily aims for generalisation, it is not the main purpose of a non-probability sampling.

This research seeks to obtain a representative sample for the purpose of validating the proposed theoretical framework. Therefore, probability sampling technique best fits with the main objective of this study. Indeed, statistical inferences drawn from a probability sampling allows us to substantiate preliminary conclusions on the association between the research constructs (Sinharay, 2010). As presented earlier, quantitative research is based on the logic of a deductive approach in which a theory is derived from an extensive literature review and data is collected to test and verify causal relationships constituting the theory. Therefore, the examination of these causal relationships resting on probability sampling enables us to make judgement on the relationships between the variables of interest happening not by chance (Smith, 2017).

### ***Sample Size***

An ideal sample size required to make an estimation is one that is neither too small nor very large, but rather is one with an optimum size (Kothari, 2008). A number of different criteria are proposed to obtain an optimum sample size (Kothari, 2008, Saunders et al., 2012, Bell et al., 2015, Nardi, 2018): (1) sample representativeness and the level of confidence required to make valid inferences from the sample to the population; (2) the size of and the amount of variation existing in the target population; (3) the level of accepted sampling error which does not compromise the degree of precision and accuracy in making valid inferences; (4) the number of main constructs used to study a certain phenomenon (5) the techniques used for data analysis. It is argued that results generalisation and suitability of selected statistical techniques could be affected by a poor sample size, resulting in Type I (statistical significance of the results) or Type II (statistical power of the test) errors (Baroudi and Orlikowski, 1989, Verma and Goodale, 1995, Forza, 2002). These are associated with statistical inaccuracy which can contribute to the measurement quality and thus the reliability and validity of statistical findings (Baroudi and Orlikowski, 1989). Table 4.5 shows how to determine the optimum sample size depending on the desired significance level and statistical power. These two factors hold reverse relationship with the required sample size. As the statistical power increases so does the sample size. However, the sample size decreases when increasing the desired significance level.

*Table 4.5. Sample Size Determinants Adopted from Forza (2002)*

	Stat. power=0.6		Stat. power=0.8	
	$\alpha=0.05$	$\alpha=0.01$	$\alpha=0.05$	$\alpha=0.01$
Large effect (e.g. strong association)	12	18	17	24
Medium effect (e.g. medium association)	30	45	44	62
Small effect (e.g. small association)	179	274	271	385

Decisions about sample size involves both practical and statistical considerations. This research obtained a sample size of 224 responses. With the online surveys in OM and SCM research expecting to receive a response rate of roughly 10% (Klassen and Jacobs, 2001), the sample size seems to be adequate. Several studies have been published in these fields with response rate of 10% (Flynn et al., 1990) or lower (Inman et al. (2011) with 7.9% response rate and Tachizawa and Gimenez (2010) with 5.1%). Thereby, drawing on this response rate (i.e. 10%) and with the sample frame of 3,961 firms, a sample of 396 would be deemed accepted. However, it is suggested that in multivariate analysis which is used as the statistical technique in the current research, as a rule of thumbs sample size should be 10-15 times as large as the number of variables in the study (Hair et al., 2014). Therefore, having seven key variables in this research the obtained sample size (i.e.224) is considered appropriate. As for the practical considerations, there is always a compromise between sample size adequacy and the available practical limitations, which should be addressed prior to sample size evaluation (Bell et al., 2015). Some of these practical considerations affecting the sample size are budgetary constraints, time and resource limitations (Saunders et al., 2012). Discussion on the sample size will further be elaborated on in Chapter Five.

### ***Pilot Study***

In order to evaluate the feasibility of a survey research a small-scale preliminary study called pilot study is conducted prior to the major research. This is carried out to improve the design of a particular research instrument (e.g. interview or questionnaire) (Van Teijlingen and Hundley, 2001). While the findings from pilot study could be included in the actual analysis, it is also used to prepare the data collection instrument for the major study (Polit and Hungler, 1994). To ensure the validity of the survey instrument, i.e. draft questionnaire, and enhance its reliability during the process of data collection a pilot study was administered with both academics and practitioners to “keep questionnaire revision to minimum” (Hensley, 1999, p.348). Pilot study, in this research, essentially refers to a means deployed to solicit feedback, from a convenient sample accessible to the researcher, in order to evaluate the wording and seminal meanings of the questionnaire items and eliminate any possible ambiguity. Hence the results are not incorporated in the final model which is the main purpose of pre-testing used as an integral part of a survey design (Yin, 2009). Therefore, the pilot study

is solely conducted to further improve face validity, content validity and the reliability of the questionnaire.

The first draft of the questionnaire was emailed to a panel of five academics and five field experts. A total of four academics and four practitioners returned back with completed questionnaire along with their comments. The selected academics were not provided with any initial introduction of the research purpose to avoid biased feedbacks, except the researcher supervisor who was deliberately selected to gain his insights into the content of the questionnaire as well as any relevant technical issues. The pilot test was administered to examine the questionnaire format, the order and flow of the questions, any wording issues, and the feasibility in terms of the duration of the questionnaire. In general, it was suggested to avoid lengthy questionnaire as this could affect the response rate. This was particularly due to the respondents time limitation in high- and medium-tech manufacturing firms and the possibility of losing interest in their participation. In particular, they raised the following issues:

- Beyond the introductory statement, the questions were generic and not specific to the high- and medium-tech manufacturing firms, hence respondents may lose relevance and perhaps interest on the subject.
- The language used in the questionnaire was found too complicated. Some technical phrases and acronyms, such as internal integration (II), and business process orientation (BPO) had to be simplified. The word count was suggested to be reduced in order to avoid respondents misunderstanding, increase the response rate, and also improve the questionnaire consistency.
- The use of 'key business process' was found to be confusing, so a clear definition of it was provided at the beginning of the questionnaire.
- It was found that some of the scales could be combined into one to cut down the length of the questionnaire.
- There was a lack of consistency in the structure of the questions. Some of which were designed to obtain information about the general situation, while a few were related to the respondents' personal experience of the concepts under study. Thus, the questions were rephrased to improve the questionnaire reliability.

Taking into consideration the above feedbacks from the pilot study the questionnaire was refined and the instruction and wording were further improved.

### ***Measurement Instrument***

A survey research is recognised to hinge on a structured data collection instrument to obtain particular information. The survey instrument should be designed in a way to cover the domain of a construct theoretical conceptualisation (Forza, 2002). This research used questionnaire as the main measurement technique for data collection. The refined version of the questionnaire is presented in Appendix 4.1. This method is commonly used as the main data collection technique in empirical production and operations management (POM) studies (Malhotra and Grover, 1998). The development of a structured survey instrument involves a number of different criteria, including the wording, presentation (layout), scaling, respondent identification and rules of questionnaire design (Forza, 2002, Bell et al., 2015). One of the key aspect of constructing the instrument is to use simplified language in order to maintain the consistency among participants understanding of the questions (Forza, 2002). If the respondents fail to comprehend and interpret the questions in the same way, the results obtained lack reliability and validity. Therefore, the wording issues are considered in order to ensure unbiased responses and warrant the consistency in respondents level of understanding of the content of the questions (Neuman, 2014). Some of the most cited wording issues are double-barrelled questions, ambiguity, leading questions, lengthy questions containing more than 20 words, double negatives, the use of jargons, technical words and abbreviations (Converse et al., 1986, Oppenheim, 1992, Forza, 2002, Neuman, 2014). In developing the survey instrument these issues were carefully examined and an appropriate wording structure was maintained throughout the questionnaire.

A questionnaire presentation is equally important, particularly in an online survey. It is suggested that for an online questionnaire, because of the lack of interaction between the researcher and participants, the survey layout should be clearly designed and the respondents must be provided with a clear instruction for completing the questionnaire (Sue and Ritter, 2007). Respondents were provided with a clear instruction on how to complete each section of the questionnaire. For the ease of statistical analysis and increasing integrity throughout the questionnaire, multiple choice questions (Likert-scale), most commonly employed in online surveys, were used. This allows the respondents to easily select an answer from a list of displayed choices. It also provides an effortless control of their responses for the researcher when it comes to analysis (Bell et al., 2015). The response options were presented in a form of check boxes designed vertically for both background questions as well as the questions related to measuring BPO, II and PM. The use of vertical closed answers had the merit of preventing respondents from selecting the wrong answer by allowing them to clearly distinguish the response options. It also made the process of coding the response options easier for the researcher at the analysis stage (Forza, 2002, Neuman, 2014, Bell et al., 2015). At the end of each section one open-ended question was also included to allow the respondents to

provide further comments. The use of online questionnaire granted the permission to the respondents to update their responses by returning back to pages they had already visited.

To eliminate the risk of ‘order effects’, each section was designed to be in a separate page with a progress bar displayed on top of each page. “Order effects occur if respondents’ answers to particular questions are influenced by previously reordered answers” (Sue and Ritter, 2007, p.78). This also helps to eliminate the risk of respondents premature termination of the survey due to loading all the questions in a single page. The use of a progress bar allowed the respondents to keep track of their progress towards the completion of the survey. The survey included eleven sections: (A) the front page including the respondents consent form (B) screening questions (C) background questions (D) a brief instruction on how to complete the main research questions (E) questions on process job (F) questions on process view (G) questions on process management & measurement (H) questions on process structure (I) questions on customer-focused process values & beliefs (J) questions on internal integration (K) questions on product modularity. These questions were designed to take up to ten minutes to complete. This is considered a medium length survey in which the response rate is expected to be higher (Sue and Ritter, 2007, Neuman, 2014). The participation of the respondents was contingent on their eligibility which was assessed through two screening questions in the beginning of the survey. This helped to only include those who have the knowledge and relevant information about the main constructs of this research (Baker, 2006).

### ***Questionnaire Reliability and Validity***

*Reliability* is concerned with the extent to which a questionnaire or measuring procedure could produce the same results on repeated trials (Bell, 2014). It refers to internal consistency, and statistical techniques (e.g. Cronbach’s  $\alpha$  (Santos, 1999, Forza, 2002)) can be used to measure if the underlying concept is precisely measured by its constituent items (Bryman and Cramer, 1997, Saunders et al., 2012). *Validity* refers to the extent to which a chosen scale measures what it is expected to measure (Yin, 1994, De Vaus, 2014) and is the most critical aspect of theory testing study (Forza, 2002). Three types of measure’s validity are represented here as face validity, content validity, and construct validity (convergent and discriminant validity) which are categorised as internal validity. Face validity is concerned with the degree to which a measure appears to reflect and is an indication of the concept of interest (Bell et al., 2015). Content validity concerns how accurately a measure could represent various facets of a construct. And finally, construct validity looks into the extent to which a scale could measure a hypothetical construct. Indeed, it assesses “how well the measure conforms with theoretical expectations” (De Vaus, 2014, p.54). A construct validity is evaluated empirically through two measures of convergent and discriminant validity. The former is concerned with the “convergence between measures [...] of the same constructs”, while the

latter refers to the separation between measures [...] of different constructs” (Forza, 2002, p.178). A distinction is made between the above three forms of validity and internal and external validity recognised as a different validity category. Internal and external validity concerns the assessment of the observed findings and the extend of the findings generalisability. More precisely internal validity focuses on the level of confidence that could be placed on establishing a causal relationship between research constructs. And external validity is related to findings generalisability beyond and outside the context of a research (Forza, 2002, Bell et al., 2015).

The quality of the scales and measures employed in this research is ensured through examining their reliability and validity. Assessing reliability and validity is at the heart of establishing research findings credibility (Neuman, 2006) which are ensured through a number of stages in this research. These entail increasing transparency in the questionnaire wording through conducting pilot study, using multi-item and validated scales from past studies (e.g. Ketokivi and Schroeder, 2004, De Vaus, 2014), and employing statistical tests such as Cronbach’s coefficient alpha (Santos, 1999, Forza, 2002). Appendix 4.2 shows the key measures adopted from the past studies based on rigorous and well-established conceptualisation of each concept in existing literature (Forza, 2002). These scales are adopted to reflect on different aspects of the constructs of interest in order to increase internal consistency. The rationale behind using the adopted scales will be discussed in more detail in section 4.4.4. In addition, to establish constructs validity, suitable statistical tests are applied and will be elaborated on in Chapter Five. Furthermore, internal validity was addressed through drawing the cause and effect relationships from the literature, the inclusion of control variables, and the use of some statistical tests which will be illustrated in chapter Five. While external validity was ensured to an extent through obtaining an appropriate sample frame and the use of techniques increasing the response rate (Malhotra and Grover, 1998, Scandura and Williams, 2000).

### ***The Use of Likert-Type Scales for Measuring Items Responses***

In measuring the questionnaire items, this research adopts Likert-type scale which utilises an internal measurement level and is the most common technique for rating questions (Gliem and Gliem). However, it has long been a debatable issue among scholars as to which number of scale point is best for capturing respondents’ answers effectively. While some studies might use 10- or 11-points Likert scale, 4- to 7-points are most used by the majority of researchers (Cox, 1980, Leung, 2011). This research utilises a 7-point Likert scale to design the scales responses in the questionnaire, seeking to identify the level of agreement or disagreement of each respondent on a series of statements. It is argued that data and results might be affected due to scales format. One reason is an increased sophistication of existing

analytical tests which lead to an increased sensitivity of the results to some data characteristics such as skewness, kurtosis, mean score, etc. (Dawes, 2012).

Drawing on several studies, Leung (2011) compares 4-, 5-, 6-, and 11-point Likert scales in terms of their normality and psychometric characteristics. He argues that, considering the normality of each scale point, 6- and 11-point scales are normally distributed unlike 4- and 5-point scales. This suggests that 6- and 11-point scales result in less variation than a 4- and 5-point scale. However, the scales with middle /neutral points (5- and 11-point scales) were not found to compromise the data quality. Nevertheless, long scales are recommended to dilute the possible impact of a neutral point. Despite the suggested merit of a long scale, it could potentially increase the level of respondents fatigue and premature survey termination, and as a result affect the response rate (Neuman, 2006, Sue and Ritter, 2007). Therefore, it is believed that a 7-point scale would better fit with the current research due to several reasons. First, it is argued that a higher number of scale points could hamper the goodness of fit in measurement model, resulting in a lack of fit between the data obtained and the model (Chang, 1994). Moreover, this research is looking to avoid aspects affecting the response rate, since an online questionnaire is more prone to suffer from low response rate (Forza, 2002), as discussed previously. As such, a lengthy questionnaire could be avoided without compromising its reliability and validity (Neumann and Neumann, 1981, Chang, 1994, Coelho and Esteves, 2007). Furthermore, this research aims to increase the scales sensitivity and cover a larger proportion of response continuum while avoiding over lengthy responses. Anchored in the above arguments, a 7-point scale is adopted to measure the survey's questions where 1= Strongly Disagree and 7=Strongly Agree.

#### **4.4. Research Process**

This section draws on the survey technique employed for data collection, elaborating on the questionnaire design and administration, the selection of target respondents, the unit of analysis, and finally discussing the key research variables and their scales operationalisation.

##### **4.4.1. Data Collection Technique: Self-Administered Survey**

This research employs a self-administered questionnaire as the main method of data collection to test the hypotheses developed in Chapter Three. Table 4.6 presents the hypotheses developed under this study. Despite some reported disadvantages of an online self-administered survey (e.g. the chance of distortion in responses, the need for computer literacy, the lack of interaction between the researcher and respondents, etc.), it is deemed the most suitable data collection technique due to several reasons. Online questionnaire is employed to facilitate the management of data gathering procedure and the interaction with potential

informants locating in distant locations (Göritz and Crutzen, 2012). It further helps effectively with follow ups process to increase the response rate, and provides flexibility in data storage process and converting data from an online platform to statistical programmes. It is also considered a more efficient, and time and cost-effective data gathering technique in a survey research (Saunders et al., 2012, Göritz and Crutzen, 2012, Neuman, 2014, Bell et al., 2015, Sekaran and Bougie, 2016).

Table 4.6. The Research Hypotheses

Conceptual Model	Research Hypotheses
<b>The Parallel Model</b>	<b>Hypothesis 1.a (H1.a +):</b> “The degree of process job (PJ) has a positive impact on the degree of internal integration (II).”
	<b>Hypothesis 1.b (H1.b +):</b> “The degree of process view (PV) has a positive impact on the degree of internal integration (II).”
	<b>Hypothesis 1.c (H1.c +):</b> “The degree of process management & measurement (PMM) has a positive impact on the degree of internal integration (II).”
	<b>Hypothesis 1.d (H1.d +):</b> “The degree of process structure (PS) has a positive impact on the degree of internal integration (II).”
	<b>Hypothesis 1.e (H1.e +):</b> “The degree of customer-focused process values and beliefs (CFPVB) has a positive impact on the degree of internal integration (II).”
<b>The Mediation Model</b>	<b>Hypothesis 2.a (H2.a +):</b> “PJ mediates the positive effect of PS on II.”
	<b>Hypothesis 2.b (H2.b +):</b> “PV mediates the positive effect of PS on II.”
	<b>Hypothesis 2.c (H2.c +):</b> “PMM mediates the positive effect of PS on II.”
	<b>Hypothesis 2.d (H2.d +):</b> “PJ mediates the positive effect of CFPVB on II.”
	<b>Hypothesis 2.e (H2.e +):</b> “PV mediates the positive effect of CFPVB on II.”
<b>The Hierarchical Model</b>	<b>Hypothesis 2.f (H2.f +):</b> “PMM mediates the positive effect of CFPVB on II.”
	<b>Hypothesis 3.a (H3.a +):</b> “PMM has a positive effect on the level of II, given that PJ is already developed.”
<b>Product Modularity (PM) Moderation Effect</b>	<b>Hypothesis 3.b (H3.b +):</b> “PV has a positive effect on the level of II, given that PJ and PMM are already developed, respectively.”
	<b>Hypothesis 4.a (H4.a -):</b> “The effect of process job (PJ) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”
	<b>Hypothesis 4.b (H4.b -):</b> “The effect of process view (PV) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”
	<b>Hypothesis 4.c (H4.c -):</b> “The effect of process management & measurement (PMM) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”
	<b>Hypothesis 4.d (H4.d -):</b> “The effect of process structure (PS) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”
	<b>Hypothesis 4.e (H4.e -):</b> “The effect of customer-focused process values and beliefs (CFPVB) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”

### Survey Administration

Qualtrics, an online survey platform, was used to design and administer the questionnaire. The final version of the questionnaire was created, using several Qualtrics features (e.g. screening questions, skip logics, force response feature, etc.) in order to improve the quality of the survey and mitigate some of the limitations of online survey mentioned earlier. This platform allowed mobile survey optimisation, thereby the survey was created to be compatible with mobile devices too. The survey was distributed to a mailing list of relevant managers and executives obtained and created from the FAME database (the use of the FAME database will be discussed in more detail in section 4.4.2). This method of invitation email



with the link to survey embedded in it is suggested as an effective technique which ensures participants anonymity (Sue and Ritter, 2007). A sample of the invitation email is provided in Appendix 4.3. Each email was customised, including the name of the respondent, the objectives and significance of the study, an incentive note offering to provide a report of the findings upon their request and a £50 Amazon voucher prize draw, and the link that navigated them to the survey front page (which also allowed them to leave the survey and continue at any time using the same link). The respondents were also informed about their confidentiality and the research ethical consideration ensured through complying with Royal Holloway Research Ethics Guidelines (Royal Holloway University of London Ethics Committee, 2010).

The survey administration was performed in four stages to secure a satisfactory response rate (Forza, 2002). The first round of data collection commenced on in mid-August 2017 when the companies were contacted via email including a link to the survey. The built-in features of Qualtrics facilitated the process of monitoring and tracking the number of completed questionnaires as well as those still in progress. This allowed to see the number of responses immediately without having to count them manually. A follow-up letter was emailed to the respondents two weeks later. Using the Qualtrics platform the process of follow-up emails was facilitated by automatically removing those who already responded from the mailing list. During the first and second rounds of data collection a large number of emails were returned back with an 'out of office' message. This was due to the time period (August) the data collection commenced on, which compelled the researcher to conduct a third and fourth follow-up later in mid-October 2017. The data collection was completed in late October 2017 with a total of 224 responses obtained which is deemed a reasonably suitable number given that this research is solely grounded on quantitative method. At the end of each round those respondents completed the questionnaire were approached again by sending them a thank you email for their participation.

To ensure that the participants who agreed to participate in the survey have the appropriate knowledge in terms of the key business processes within their organisations, two screening questions were formulated and located in the beginning of the questionnaire (Baker, 2006). The first question asked about the duration which participants have been in the organisation and those who answered yes to 'more than 1 year' were eligible to continue to the second screening question. Otherwise, they would automatically be navigated to the end of the survey. The second screening question was designed to ensure about their knowledge on their key business processes and asked them about their involvement in the processes. Those respondents who did not deal with the key business processes were opted out of participation in the study. The processes included demand creation, design and development, pre-construction, project fulfilment, and post-project management. If they selected at least one

of these processes they would be qualified to take part in the study. This allowed the researcher to screen out the respondents who did not qualify for this study (Frohlich, 2002).

### ***Response Rate and Non-Response Bias***

The mode of survey administration has an impact on non-response rate which can substantially jeopardise the research quality (Denscombe, 2009). A self-administered questionnaire is more prone to suffer from non-response bias which can affect external validity, and as such the findings generalisability (Couper et al., 2001, Forza, 2002, Denscombe, 2009). One reason is that respondents tend to be more reluctant to participate in online surveys because of data protection issues (Manfreda et al., 2008), and respondents fatigue (Lavrakas, 2008), resulting in low response rate which is argued to be a common issue in OM research. A review of 233 OM survey papers by Frohlich (2002) revealed that the average response rate has had a descending order and not improved since mid-1990s. As discussed earlier, several studies have been published in this field with an average response rate of 10% (Flynn et al., 1990) or lower. For example, Inman et al. (2011) reported a response rate of 7.9% and Tachizawa and Gimenez (2010) obtained a response rate of 5.1%..

This research employs a number of techniques to mitigate the risk of low response and non-response bias. In an attempt to increase the response rate respondents were offered monetary incentives (Amazon voucher prize draw) and the provision of a full report of the findings upon their request. Confidentiality and data protection issues were also addressed through the use of Qualtrics platform (which was already discussed). It is argued that the response rate is affected if a survey is received by the wrong recipients (Frohlich, 2002). Thus, to ensure the right and qualified respondents are approached, their contact details were also cross-checked using their companies' website. This allowed the researcher to check the accuracy of the mailing list which is one of the very first problems facing a survey researcher (Frohlich, 2002) and resulted in replacing some outdated details with the up-to-date information. Therefore, collectively the following steps were taken to minimise non-response bias prior to the surveys administration:

- Pilot testing was carried out to ensure the validity of the survey instrument, eliminate any possible ambiguity and avoid a lengthy questionnaire which is one of the main causes of low response rate (Forza, 2002)
- Cross-checking the mailing list to ensure about the accuracy of the key respondents contact details (Frohlich, 2002)
- Distribution of invitation emails to the potential respondents in four subsequent stages (follow-up emails) (Forza, 2002)

#### **4.4.2. Target Population and the Sample Frame**

This research is conducted in the UK high- and medium-tech manufacturing firms which represent the target population. With reference to the definition of high- and medium-tech companies provided by OECD, five manufacturing sectors were selected based on the UK SIC (2007) classification, including ‘manufacture of computer, electronic and optical products’, ‘manufacture of electrical equipment’, ‘manufacture of machinery and equipment n.e.c’, ‘manufacture of motor vehicles, trailers and semi-trailers’, and ‘manufacture of other transport equipment’. A more detailed explanation, including the figures, on these five sectors will be provided in Chapter Five.

Opting for potential and qualified respondents will lead to obtain relevant information answering the research questions (Kumar et al., 1993). It is argued that sampling process is generally prone to sampling frame errors which makes it unlikely to create a list excluding respondents who are not considered as the members of the population (Lavrakas, 2008). While sampling error could be avoided entirely by including the whole population in survey (See for example Slevin, 1997), this could only be performed if there is unlimited access to a finite list of the existing members of population (Sills and Song, 2002). This was not the case with the FAME database as it does not contain the list of all the UK firms registered in the five manufacturing sectors (this will be further discussed in Chapter Five). Therefore, for the purpose of ensuring the research findings validity the sampling error was minimised through using a random sampling technique (Smith, 1997, Yun and Trumbo, 2000), decreasing non-response bias, and obtaining an optimum sample size (Fricker, 2008). The sampling frame was obtained using the FAME database which contains comprehensive information on the majority of companies based in the UK and Ireland. This covers the data on senior managers/directors, financial figures, industrial description, the UK Standard Industrial Classification (SIC), company size by the number of employees, etc. The sample frame was identified from the list of directors, higher-echelon and operational level managers to consider diversity and heterogeneity factors in relation to the informants characteristics (Naranjo-Gil et al., 2008). Using a probability sampling technique, a random selection of respondents from the list was then created on Qualtrics and included in the survey administration.

#### ***The Research Key Informants***

Researchers often experience an unwilling trend among organisations or people to assent to participation in a research study (Cao et al., 2015). The use of a key informant is suggested to overcome this limitation and its application has recently received a wide attention in the field of management. In addition, while several advantages have been attached to the use of multiple informants, such as low response-bias, and increased research validity and reliability (Poutziouris et al., 2006), it is argued to suffer from difficulty to access to multiple

well-informed informants, and failing to ensure respondents anonymity (Kearns and Sabherwal, 2006). The usable response rate could also be negatively affected, thus impeding survey administration (Genç and Di Benedetto, 2015). On these bases, the key informants were selected from a list of executives and top managers provided on the FAME database who were considered to have the same level of expertise and experience about the concepts under study (Kumar et al., 1993). This was performed for the purpose of maintaining the consistency in the key informants hierarchical level and their perception of the research concepts (Conant et al., 1990). In addition, the use of screening questions allowed the researcher to only include the respondents who possessed the most relevant knowledge about the organisational level constructs (i.e. BPO, II and PM) (Conant et al., 1990).

#### **4.4.3. Unit of Analysis**

A research unit of analysis being the most basic element of a research is defined as an entity (e.g. organisation, individual, or a group) analysed to study certain aspects of a phenomenon (Sekaran and Bougie, 2016). As the unit of analysis emerges from the research questions, it is a tentative step towards a well-designed research procedure while research questions are formulated. The unit of analysis will influence the subsequent steps of the research such as method of data collection, sample size and scales operationalisation (Forza, 2002). II is an effort that spans various tasks and practices, thereby involving the commitment of a number of actors and elements. Frankel and Mollenkopf (2015) recognise that this dynamic nature is induced to change due to complex networks of relationships. They suggested that further investigation of integration is needed at a firm-level when it comes to distinctive characteristics and intuition of functional entities. A group of scholars also posit that high level of differentiation gives rise to a firm level integration to become rather complex and demanding (Thompson, 1967, Lorsch and Allen, 1973, Galbraith, 1977, Lawrence and Lorsch, 1986). Therefore, with both BPO and PM being firm-level constructs (Chen et al., 2009a, Campagnolo and Camuffo, 2010), this research sets out to study II at a firm-level to satisfy the theoretical relationship proposed under this study. Furthermore, the key informants surveyed assumed to provide information at the aggregate firm level by reporting on their firms execution of II, BPO as well as the level of PM adoption.

#### **4.4.4. Variables Scales Operationalisation**

In scale operationalisation this research follows what is proposed by Churchill (1979, p.67) as to first conducting an extensive literature review in order to “specify the domain of the construct [and delineate] what is included in the definition and what is excluded”. This research adopts the scales developed in the literature when plausible and the choice of scales

is justified on the basis of the scope of this research. In some cases, scales may have to be modified in order to become in line with the objectives of this study. To this end, the scales previously operationalised in the literature are reviewed to ensure their validity and reliability, followed by explaining their suitability to this research. Preceding the discussion about the scales employed for each variable, the following sections first identify the dependent and independent variables.

#### **4.4.4.1. Dependent Variables (II/PJ/PV/PMM)**

This research examines the proposed theoretical framework through testing three competing models developed in Chapter Three. II as the first dependent variable was proposed to be influenced by the five elements of BPO. Hence, the impact of the five identified dimensions of BPO is studied on II. In the Parallel Model, the direct impact of the five dimensions is investigated on II, so II is the only key dependent variable in this model. In the Mediation Model, the impact of process structure (PS) and customer-focused process values and beliefs (CFPVB) on II is examined through PJ, PV and PMM. Thus, in this model PJ, PV and PMM as well as II constitute the hypothesised dependent variables. In the Hierarchical Model, II remains the only dependent variable as the impact of PJ, PMM and PV is examined hierarchically on II. In this model PS and CFPVB are also the independent variables supporting each stage.

#### ***Internal Integration (II) Scales Operationalisation***

Drawing on the main theme of this research discussion presented in Chapter Two, it was argued that research contains a wide range of conceptualisations in the domain of II. A thorough review of the literature revealed that a growing body of knowledge advocates the multidimensionality of integration despite many inconsistent approaches. This indicates that integration is a latent (unobservable) variable which must be measured through a series of observable items (Gimenez and Ventura, 2005, Koufteros et al., 2005). Being primarily about people, integration is grounded on relationships happening cross-functionally and between individual from different divisions. Thus, human relationships form the basis of integration (Sweeney, 2013). While a great deal of past research mainly focused on technological aspects of integration it is excluded from scales operationalisation for the purpose of attaining measures that only constitute the perception of cooperative interdependence. This perception has been characterised as referring to two fundamental dimensions of integration, namely attitudinal/relational and behavioural (Ernst and Fischer, 2014). These two aspects have an indication of what is highlighted by a large body of research (e.g. McCarter et al., 2005, Ellinger et al., 2006, Gino and Pisano, 2008, Bendoly et al., 2010, Sweeney, 2013, Croson et

al., 2013, Tangpong et al., 2014, Wieland et al., 2016) that although integration is all about relationships happening at different levels of an organisation (e.g. team, functions, etc.), human element is fundamental at all levels. On that account, this research developed a 17-item scale by adopting the following measures from different studies. Accordingly, respondents were asked to indicate their level of agreement or disagreement on the following items on a scale of 1 to 7 where 1 being strongly disagree and 7 being strongly agree:

- *'Your organisation's functional areas/business units are jointly managed strategically' (Tang et al., 2013).*
- *'Your organisation's functional areas/business units participate in new product and process design with regards to the key business processes' (Narasimhan and ARAM, 2001).*
- *'Your organisation's functional areas/business units attend in strategic meetings with regards to the key business processes' (Narasimhan and Kim, 2002).*
- *'Functional teams are aware of each other's responsibilities' (Poirier et al., 2010)*
- *'Functional teams have a common prioritisation of customers in case of supply shortages and how allocations will be made' (Poirier et al., 2010).*
- *'All functional teams use common product roadmaps and other procedures to guide product launch' (Poirier et al., 2010).*
- *'Performance metrics promote rational trade-offs among customer service and operational costs' (Poirier et al., 2010).*
- *'Planning decisions are based on plans agreed upon by all functional teams' (Poirier et al., 2010).*
- *'Operational and tactical information is regularly exchanged between functional teams' (Poirier et al., 2010).*

Respondents were also asked to indicate to what extent they agree that their organisation's functions/business units pursue the following activities with each other. They responses were also measured on a scale of 1 to 7 as before:

- *'Achieving goals collectively' (Kahn, 1996, Ellinger, 2000).*
- *'Having a mutual understanding' (Kahn, 1996, Ellinger, 2000).*
- *'Information sharing' (Kahn, 1996, Ellinger, 2000).*
- *'Share the same vision for the organisation' (Kahn, 1996, Ellinger, 2000).*
- *'Work together as a team' (Kahn, 1996, Ellinger, 2000).*
- *'Conduct joint planning to anticipate and resolve operational problems' (Kahn, 1996, Ellinger, 2000).*

- *'People in different functions/business units are quite accessible to each other'* (Jaworski and Kohli, 1993).
- *'People in different functions/business units coordinate their activities with each other'* (Huo et al., 2016).

#### **4.4.4.2. Independent Variables (PJ/PV/PMM/PS/CFPVB/PM)**

Drawing on the three competing models, five key independent variables are identified: process job (PJ), process view (PV), process management & measurement (PMM), process structure (PS), and customer-focused process values & beliefs (CFPVB). As discussed before, in the Parallel and Hierarchical Model they all are regressed against II, yet in a different order. However, in the Mediation Model, PS and CFPVB are first regressed against PJ, PV and PMM and then against II. In other words, PJ, PV and PMM are hypothesised as mediators in this model. Furthermore, PM was theorised to moderate the BPO-II relationship. Thus, six independent variables are recognised.

Based on an extensive literature review, scale operationalisation for BPO elements was performed. A diverse range of scales adopted for the five dimensions by different studies is presented in Appendix 4.4, 4.5, 4.6, 4.7 & 4.8, indicating their multidimensionality. Drawing on this extensive list of measures, this research identified the most relevant scales reflecting a clear concept of the phenomena under study. The adopted scales were also occasionally modified to fit with the scope of the research. In addition, only those scales were selected which were clear enough to be included in the measurement instrument without major rectification. This was done in an attempt to increase clarity and avoid participants misunderstanding of the questionnaire items. Moreover, as stated before all the scales were measured using a 7-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. The following sections elaborate on the process of scales operationalisation for each independent variable.

##### ***Process Job (PJ) Scales Operationalisation***

PJ was measured using a nine-item scale. This research adopted the scales measuring the main aspects of the construct (Hinkin, 1995) already discussed as team work, problem solving, process owner and the assignment of a manager/leader to core business processes, and multidimensionality of tasks which need the cross-functional expertise. Process job has been frequently measured based on three major scales (McCormack, 1999, McAdam and McCormack, 2001, McCormack et al., 2003, McCormack, 2007, Škrinjar et al., 2008, Tang et al., 2013) (see Appendix 4.4). So, respondents were asked to state to what extent they agree or disagree that:

- *'Jobs are usually multidimensional and not just simple tasks in these processes'*
- *'Jobs include frequent problem solving in these processes'*
- *'Employees are constantly learning new things on the job which are involved in these processes'*

These scales measure those aspects of a job involving multidimensionality of tasks, problem solving, and the acquisition of new knowledge or skills cross-functionally, respectively. A broader range of items is required to render this dimension measurable in terms of the management structure approach towards the core processes. Therefore, an additional six items were adopted, whereby respondent were asked to determine the degree which they agree or disagree with the following statements regarding their firm's process owners/manager as well as the senior executive:

- *'A process owner/manager, who takes the overall responsibility and authority of the process, has been assigned to each key process'* (Reijers, 2006).
- *'Process owners/managers are experienced leaders/managers'* (Kohlbacher and Gruenwald, 2011a).
- *'The management of our organisation perceives process management not as a single project but as a way of managing the business'* (Kohlbacher and Gruenwald, 2011a, Kohlbacher, 2013).
- *'Management is committed to reviewing and improving the processes in line with the business needs'* (Reijers, 2006).
- *'There is at least one senior executive who has taken leadership of and responsibility for the key business processes'* (Kohlbacher and Gruenwald, 2011a, Kohlbacher, 2013).
- *'The senior executive team is actively engaged in the key business processes program'* (Kohlbacher and Gruenwald, 2011a, Kohlbacher, 2013).

### ***Process View (PV) Scales Operationalisation***

PV was measured using an eight-item scale measuring the degree of 'horizontal and cross-functional picture of business processes', 'a process language entailing across organisation and used by employees', and 'defining, documenting and mapping business processes', 'the clarity of jobs scope' and 'goals and objectives consistency'. PV has been frequently measured based on four major scales (McCormack, 1999, McAdam and McCormack, 2001, McCormack et al., 2003, McCormack, 2007, Škrinjar et al., 2008, Chen et al., 2009a, Škrinjar et al., 2010, Škrinjar and Trkman, 2013, Tang et al., 2013). Hence, using the following four items, respondents were asked to indicate to what extent they agree or disagree that:



- *‘Employees often view the business as a series of linked processes’*
- *‘Process terms (input, output, process and process owners) are used in the conversation made between individuals across the organisation’*
- *‘The key business processes are defined and documented by using the terms "inputs, outputs, to and from our customers"’*
- *‘The key business processes are sufficiently defined and shared with employees by managers so that most employees know how they work’*

These items examine the extent to which key business processes are defined, documented, mapped and well-understood across functional areas. In order to enhance the robustness of PV measurement, this construct was also measured by some past researchers (Movahedi et al., 2016) using a series of other scales (see Appendix 4.5). Following their approach and in line with the scope of PV definition this research selected the following four items to further expand on jobs clarity, goals and objectives consistency:

- *‘There is a ‘system view’ in place (i.e. the entire process is managed)’*
- *‘Management tries to eliminate resistance to change by providing a clear vision, and well-defined roles’*
- *‘Managers convey consistent objectives and a viable vision and strategy to employees with regards to the key business processes’*
- *‘Managers communicate a defined business process view through training and learning opportunities’*

#### ***Process Management & Measurement (PMM) Scales Operationalisation***

PMM primarily examines the extent to which process measures and performance goals are defined within an organisation and in line with the business overall strategy. For measuring this construct this research adopts the five key scales which have been frequently used in the literature, see Appendix 4.6 (McCormack, 1999, McAdam and McCormack, 2001, McCormack et al., 2003, McCormack, 2007, Škrinjar et al., 2008, Škrinjar et al., 2010, Tang et al., 2013, Movahedi et al., 2016). Therefore, respondents were asked to indicate to what extent they agree or disagree with the following statements:

- *‘Process measurements (e.g. output quality, cycle time, process cost and variability) are defined for the key business processes’*
- *‘Specific process performance goals (e.g. target output quality, target cycle time, target process cost and target variability) are in place for the key business processes’*
- *‘Process performance (e.g. customer satisfaction, output quality, cycle time) is measured for the key business processes’*

- *‘The key business processes outcomes (e.g. real output quality, real cycle time, real process cost and real variability) are measured’*
- *‘Resources (e.g. people, expenses, and other capital) are allocated based on the needs of these key business processes’*

Furthermore, reviewing the literature provided the opportunity to identify some other relevant scales which could further expand the five key items to also include the continuity of performance measurement for continuous improvement. In line with this, some past researchers (Melão and Pidd, 2000, McAdam and McCormack, 2001) in the context of business process management (BPM) have also emphasised the need to address the provision of feedback to employees. Therefore, inspired by the three scales of ‘performance goals for continuous improvement’, ‘performance results are used in setting improvement targets’, and ‘performance indicators are communicated within the organisation on a regular basis’ selected from Bronzo et al. (2013), Škrinjar et al. (2010), and Škrinjar and Trkman (2013), the following scale was also added:

- *‘There are feedback loops between functions for ongoing learning and improvements in the key business processes’*

#### ***Process Structure (PS) Scales Operationalisation***

As opposed to the last three dimensions, there is a lack of consistency between the scales operationalised for measuring PS in the literature, see Appendix 4.7. To develop an extensive measurement instrument for a thorough examination of this construct this research adopts the selection of scales already tested and validated and are in line with the objectives of this research. PS assesses the extent to which a horizontal organisational structure which is compatible with key business processes is entailed within a firm. Drawing on the domain of PS conceptualisation four relevant scales were identified and adopted/adapted from Santos et al. (2014), Bronzo et al. (2013), Škrinjar and Trkman (2013), Škrinjar et al. (2010) and Reijers (2006). These items essentially measure the aspect of cross-functional teamwork and collaboration as well as cross-functional flow of activities. Therefore, respondents were asked to indicate their level of agreement or disagreement regarding their organisational structure on the four following items:

- *‘The organisation structure supports seamless execution of key business processes across functions’*
- *‘The firm’s organisational structure facilitates integration of flow of activities between functions’*

- *‘Nearly all activities are executed by cross-functional teams, to which employees are being assigned’*
- *‘The organisation has functional areas, but employees regularly participate in cross-functional teams’*

In addition, ‘the organisational structure can best be described and illustrated as a collection of processes’ was selected from Trkman (2010) and Reijers (2006) to measure their general perception of their organisational structure.

#### ***Customer-Focused Process Values & Beliefs (CFPVB) Scales Operationalisation***

CFPVB assesses the extent to which the culture and sense of commitment to customers is prevailed within a firm. It also examines the extent to which internal and external customers are well understood and defined across functions. This construct has been operationalised frequently based on relatively similar scales which accommodate the predominant scope of its definition. Therefore, to perform the most effective measurement of this construct the scales were adopted from Movahedi et al. (2016), Bronzo et al. (2013), and Kohlbacher (2013), see Appendix 4.8, whereby respondents were asked to state to what extent they agree or disagree with regards to their organisation’s approach towards its customers using a seven-item scale:

- *‘The customer is central to the organisation’s business model’*
- *‘Employees pay attention to the customer’s needs in their jobs which are involved in the key business processes’*
- *‘Employees understand that the purpose of their functional area is to fulfil the needs of the internal/external customers’*
- *‘Individuals on all levels of the organisation are speaking about business processes, customers, teams, process performance indicators, and so on’*
- *‘Employees know their work affects subsequent works, customers, and the key business processes performance’*
- *‘Customer satisfaction is used on a regular basis’*
- *‘Customer feedback is used intensively to improve product quality’*

#### ***Product Modularity (PM) Scales Operationalisation***

PM has been conceptualised as a multidimensional variable, and literature review revealed a number of features and definitions assigned to it, such as reusability, interchangeability, standardisation and decomposability. It was, though, argued that it is mainly characterised as a continuum of three key concepts of “separateness”, “specificity”,

and “transferability of product components in a product system” (Antonio et al., 2009, p.307). On that basis, this research identified and selected the scales originally developed and validated by Antonio et al. (2007) and adopted/adapted later by some other researchers (e.g. Danese and Filippini, 2013, Boer, 2014). The scales are considered to be the corresponding indicators of product modularity definitions. Therefore, the respondents were asked to determine how they would describe their main products, and their answers were measured using a 7-point Likert scale on the following statements:

- *‘Product can be decomposed into separate modules’*
- *‘We can make changes in the key component without redesigning others’*,
- *‘Product components can be reused in various products,*
- *‘Product has high degree of component carry-over’*,
- *‘Product’s components are standardised’.*

#### **4.4.4.3. Control Variables**

The inclusion of a control variable could aid the process of estimating the effect of an independent variable on a dependent variable by improving the estimation accuracy (Nardi, 2018). This research employs two control variables to address the issue of spuriousness and improve reliability in the causal inferences:

- Organisation size: A firm size i.e. both SMEs and large firms, has been frequently adopted as control variable within the context of integration (Narasimhan and Kim, 2002, Vachon and Klassen, 2008, Prajogo and Olhager, 2012). In addition, with the most widely accepted SCM practices used successfully in larger firms compared to SMEs, the outcome of this research is more likely to be influenced (Harland et al., 2007, Koufteros et al., 2007). Accordingly, we use firm size measured based on annual sales and number of employees, as a control variable (Graham et al., 2015, Danneels, 2016).
- Industry classification: It is argued that “controlling industry effects can compensate for variability between industries” (Flynn et al, 1999, p.260). Drawing on the research context, i.e. high- and medium-tech manufacturing sector in the UK, various types of industries were considered to enhance the replicability of the study (Forza, 2002). Hence, as it was previously mentioned five manufacturing sectors were selected according to the UK SIC (2007) classification, which will be explained in more detail in Chapter Five.

#### **4.4.5. Ethical Considerations**

It is critical to ensure the confidentiality of data collected throughout a study. This research is conducted following Royal Holloway Research Ethics Guidelines (Royal Holloway University of London Ethics Committee, 2010), which ensures the anonymity of the participating companies and individuals, and the protection of the data collected. In an attempt to address the ethical principles this research effectively communicated the main objectives with the key informants both in the invitation email as well as the online questionnaire consent page. This was performed to reassure them that this research is merely conducted for an academic purpose and the information provided is not disclosed to anyone other than the researcher without their consent. The invitation email also contained the information about who conducts and sponsors the research and the researcher email address if they wish to contact her for further information. Participants were informed that their answers will be kept in the strictest confidentiality throughout the study and their permission was obtained through a consent form provided in the beginning of the survey. Respondents were also informed that the data collected will only be disseminated to the managers or any stakeholder in participating companies if they request for it, while ensuring their anonymity. Data protection and confidentiality issues were further ensured, using Qualtrics online survey platform on which all accounts are hidden behind passwords which only an account holder (in this case the researcher) has access to.

#### **4.4.6. Chapter Summary**

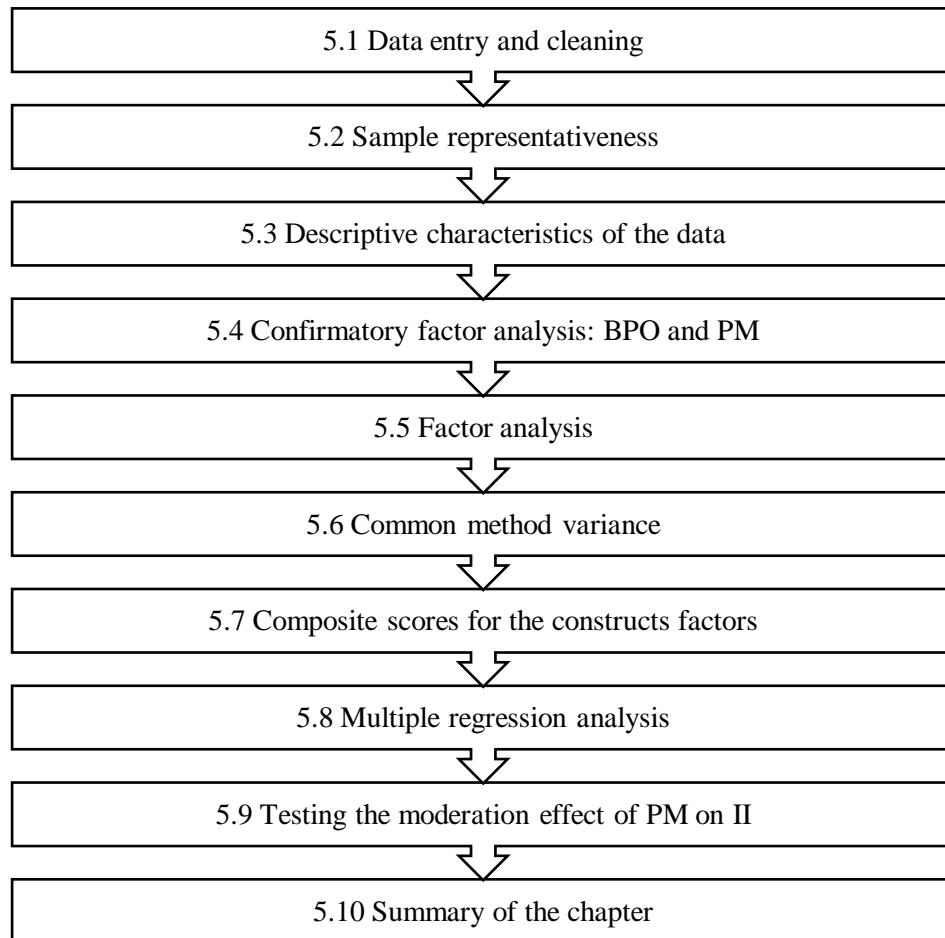
This chapter discussed the philosophical and methodological aspects of the research, elaborating on the key approaches adopted to answer the outlined research questions through examining 18 research hypotheses. Having argued the shortcomings of a pure positivist and interpretivist in regard to the research objectives, this research adopted a deductive critical realist approach to alleviate the complexities involved in investigating the causal relationship between the research constructs. The chapter presented a discussion on the development stages of the field research and the methodological fits associated with them.

Furthermore, the research context was rationalised, emphasising the need for further research on firm-level integration within high- and medium-tech manufacturing sector. In addition, the research practical considerations were highlighted, suggesting the issues influencing the methodological decisions. Additionally, the research data collection technique as well as the research process (e.g. survey administration, scales operationalisation, etc.) were discussed. Finally, the chapter highlighted the ethical considerations, and discussed the steps taken in relation to respondents confidentiality and data protection. The following chapter will present the quantitative examination of the research findings.

## Chapter Five: Data Analysis

### 5. Introduction

Earlier in chapter Four the philosophical and methodological aspects of the research were discussed. This chapter aims to scrutinise survey data through adopting a series of statistical techniques. Some major steps are taken prior to the main analysis in order to prepare and validate the data. First, a detailed examination of the data quality and structure is conducted to assess the suitability of the data collected. This entails data screening and coding, non-response bias check and dealing with missing data. This step is followed by conducting EFA (exploratory factor analysis) and CFA (confirmatory factor analysis) to examine the reliability and validity of the research variables. Finally, the research hypotheses are tested using multiple regression analysis (MRA) (on SPSS), and structural equation modelling (SEM) (on AMOS). The results are then discussed from statistical point of view. Figure 5.1 outlines a more detailed summary of the chapter structure.



*Figure 5.1. Summary of Chapter Five Structure*

## 5.1.Data Entry and Cleaning

In order to improve data quality and prepare them for analysis quality inspection was undertaken through some checks. Having used Qualtrics platform as the main data collection tool, the researcher was allowed to pre-organise the questionnaire responses before importing them into SPSS (Statistical Package for the Social Sciences). The built-in features of Qualtrics facilitated the process of data configuration and data management. Raw data can be exported automatically from Qualtrics into SPSS which includes all the survey's raw response data. Nevertheless, to ensure data are stored in the correct format a thorough check was carried out by the researcher. As some of the coding did not match the researcher expectations, the adjustments were made to insure the consistency of the data coding. In some cases where Qualtrics did not recognise the text format and the data did not appear on SPSS file, the researcher inserted the data manually, although, Formatting Answer Choice was performed when designing the questionnaire. A code was then assigned to each item to ease variables tracking and analysis process, see Table 5.1.

*Table 5.1. Research Variables and Assigned Codes*

Constructs	Variables	Codes	No. of Items
<b>Internal Integration (II)*</b>	Cooperative Task Planning Orientation	CTPO	9
	Cooperative Communication	CC	8
<b>Business Process Orientation (BPO)</b>	Process Job	PJ	9
	Process View	PV	8
	Process Management & Measurement	PMM	6
	Process Structure	PS	5
	Customer-Focused Process Values and Beliefs	CFPVB	7
<b>Product Modularity (PM)</b>	Product Modularity	PM	5

*\* II variables were extracted from EFA analysis which will be explained in section 5.5.5.1*

### 5.1.1. Response Rate

Despite performing all the checks, it was identified that out of 3,961 email invitations, there was a total of 656 emails bounced back and 302 emails failed to deliver to the respondents. This resulted in an effective sample frame of 3,003 manufacturing firms. Out of 774 people who started the questionnaire 152 people chose not to participate in the survey, and 299 left the questionnaire incomplete (they only answered the first few questions and left the rest blank). They attributed their unwillingness to participation to several reasons, such as their firm's policy, did not operate in the UK, was not a manufacturer, was no longer an employee at the firm and time restriction. Using two screening questions in the beginning of the survey, 99 respondents did not qualify to participate in the study. Therefore, over the course of two and a half months, from mid-August 2017 to late October 2017, a total of 224 responses were received, and the response rate of 8% ( $224/(3003-152-99)$ ) was obtained. As it has been argued in the preceding Chapter (see Sample Size section), this seems to be in

favour of some of the past research in operations management (OM). Moreover, although online surveys are more prone to individuals self-selection compared to personal interviews and telephone surveys (Forza, 2002), 224 responses is deemed to be a reasonable sample size on the basis of 10:1 ratio to carry out multiple regression. This research consists of seven key constructs requiring 10 observations each. Hence, 224 observations are considered adequate to conduct multiple regression analysis (MRA)

### **5.1.2. Non-Response Bias Assessment**

In order to ensure that non-response bias does not influence the sample frame representativeness non-respondent should be assessed prior to main analysis (Forza, 2002). To check the non-response bias an Independent Samples t-test was conducted to check the difference between the first wave of returns and the last batch of responses (the proxy for non-respondents) received based on two scales (Ehie and Madsen, 2005), i.e. annual sales, and organisation size. Those questionnaires returned within a week of emails distribution from 17<sup>th</sup> of August were considered to be early responses (almost the first 25% responses). And those who responded after emailing fourth follow-up letter were referred to as late respondents (almost the last 25% responses). The result of the test revealed that there was no significant difference between the two groups, suggesting that the result will not be influenced by non-response bias despite the response rate of 8%. As it was already stated, the delay in response of those who participated in the study after the third and fourth follow-up letters was due to the time period of data collection. Most of the potential participants were on holiday during the first two rounds of emails. Thus, this could also support the result obtained from the t-test.

### **5.1.3. Handling the Missing Data**

Missing data is a common issue in OM online surveys (Tsikriktsis, 2005) and could negatively affect the statistical power of a study (Croson et al., 2013). In order to make an appropriate course of action and prepare data for the main analysis, a researcher should make a judgment on the reasons for the missing data, their adequacy to account for certain patterns, and the way to deal with them (Diamantopoulos and Schlegelmilch, 1996, Little and Rubin, 2014, Hair et al., 2014). Missing values could occur due to several reasons, such as participants overlooking to answer a question, incorrectly answering an item, leaving a question blank intentionally due to data protection reasons, lack of having available information and data entry errors (Allison, 2002, Bell, 2014). In the simplest form, missing data can be eliminated from the dataset which will result in a dataset with no missing values. However, this technique bears a major disadvantage and could significantly affect the size of a sample data. Hence,



they should be dealt with in the most effective way to avoid deleting usable cases which could produce biased data.

Prior to diagnosing the randomness of the missing data, the researcher deleted a case with no missing values as the responses seemed to be biased and have been picked in the same order for most of the items in the questionnaire. In addition, two respondents were detected to be from the same companies of which the ones with more biased responses were deleted. Moreover, in six exceptional cases after contacting the participants to complete the missing data the researcher was informed that the participants found the questions irrelevant to their business and decided to leave them blank. For this reason, these six cases were deleted from the dataset, which resulted in a sample size of 215 completed questionnaires. The researcher considered to avoid deleting the remaining cases with missing data from the data set where possible in order to retain 215 cases for analysis. Thereby, special caution was taken through running statistical analysis to identify the percentage and patterns and ensure about their randomness (Tabachnick et al., 2007).

First, missing value analysis (MVA) was run using SPSS to identify the cases with missing values as well as the variables which contain missing data. Having done the analysis, the percentage of missing values across 20 variables and across 13 cases was found to be between 0.5% and 1.4% and between 1.4% and 7.1%, respectively. Most cases had only one missing value. The highest number of missing values among the variables belonged to questions “approximate annual sales” and “approximate number of employees”, i.e. control variables. These control variables were crosschecked, using the firms website and the FAME database where their business activities, financial reports and their number of employees were reported in almost all cases. Nevertheless, financial numbers and number of employees were not reported publicly for a few companies, thus missing in the database. Some respondents clearly stated in the open-ended questions that they were not willing to disseminate this information. Figure 5.2 presents the overall summary of the missing values. With the 0.226% of missing values occurred across 13 cases the amount of missing data appears to be inconsequential (Cohen et al., 2003).

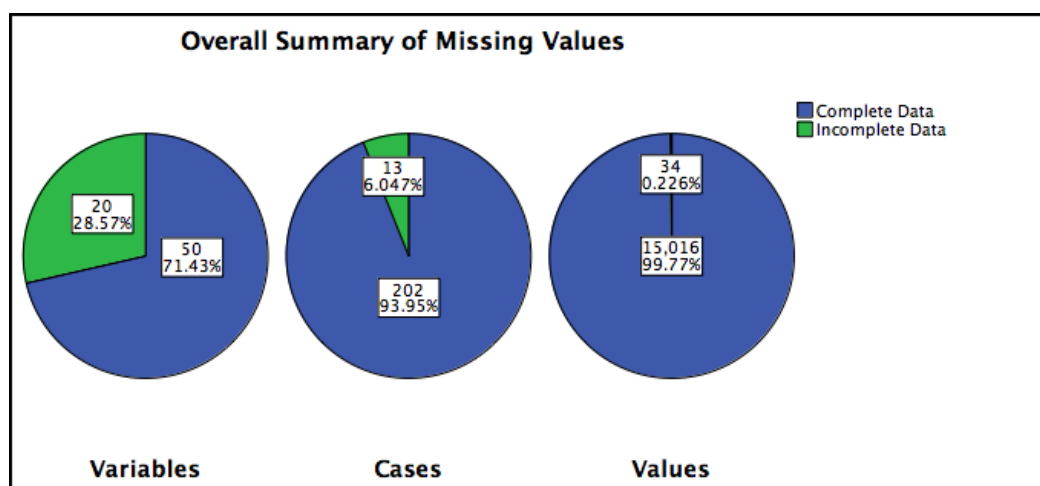
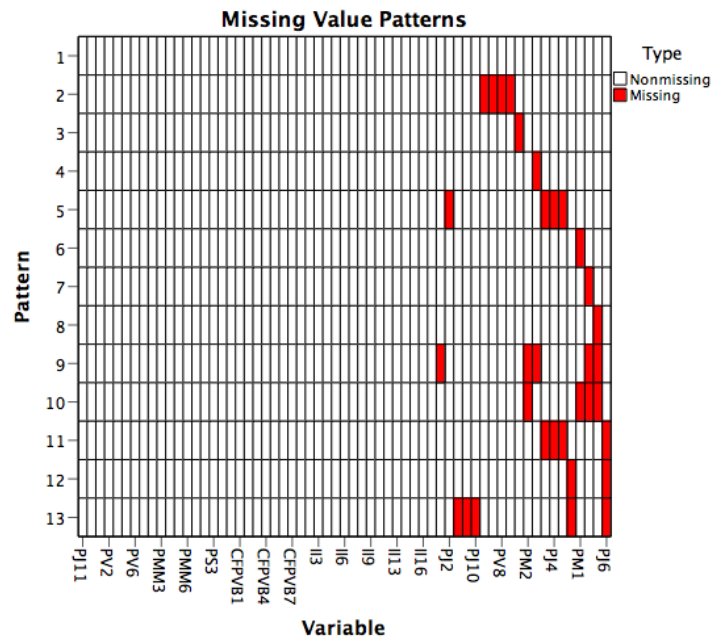


Figure 5.2. Overall Summary of the Missing Values

Tabachnick and Fidell (2007:58) argue that once the percentage was identified it is also fundamental to check on the patterns and nature of the missing values to determine how they would influence the research results. The patterns could take three forms of missing completely at random (MCAR), missing at random (MAR) and missing not at random (MNAR) (Ofori-Amanfo, 2014). Each form has a different level of influence on the research outcome, thus requires to be treated differently for data analysis procedure (de Leeuw and Huisman, 2003). Using SPSS the missing value pattern analysis was conducted, revealing that the missing values follow a stochastic pattern, see Figure 5.3 (de Leeuw and Huisman, 2003). This pattern usually reflects the items which the respondents have provided no response to which often is associated to their lack of attention that has led them to overlook some questions randomly. In such situation, the values are reported to be missing at random (de Leeuw and Huisman, 2003). Figure 5.3 reveals that PM1 to PM5, PJ1 to PJ5 account for the majority of the missing values. These were the items on product modularity (PM) and Process Job (PJ) constructs, respectively, and they were all seven-point Likert type questions. One potential reason for missing these data could be the possibility of respondents neglecting to properly check the items resulting in the loss of registering their responses.



The randomness of missing values could be tested statistically with two diagnostics tests, including univariate t-test and Little's MCAR (a multivariate t-test) proposed by Little and Rubin (2014) and suggested by several methodologists (e.g. Chen and Little (1999); Thoemmes and Enders (2007), Kim and Bentler (2002)). A potential problem with univariate t-test is that its statistical power is affected by small number of cases with missing values and could result in inaccurate means comparison conclusion (Enders, 2010). This could be overcome using Little's MCAR offering a multivariate extension of the t-test (Enders, 2010). Given the number of variables with missing values, 20 variables compared to the total of 70 variables (almost one third), the use of Little's MCAR could generate more accurate result. In addition, unlike the t-test approach, Little's test is applied to the whole dataset for the purpose of assessing "whether all of the missing data patterns in dataset are mutually consistent with the MCAR mechanism" (Enders, 2010, p.32).

missing values since they all result in true values, thus minimising the chance of biased estimates (Scheffer, 2002). On that account, single mean imputation (single replacement value) widely used Hair et al. (2014) was performed to deal with the missing values.

*Table 5.2. Little's MCAR Test Results*

	<b>Chi-square</b>	<b>Degree of Freedom (df)</b>	<b>P value</b>
<b>Little's MCAR test</b>	789.359	807	0.665

## **5.2.Sample Representativeness**

Being the sixth and the third largest industrial sector globally and nationally in terms of GBP, respectively, the UK manufacturing is a “leading exporter of technology intensive manufacturing goods” (BIS, 2010, p.1). In an analysis conducted by BIS (Business, Innovation and Skills) in 2010 this sector accounting for an employment rate of 2.6 million people is reported to have contributed almost £140 billion in gross value added to the country economy (BIS, 2010). According to the report from Business Population Estimates 2016<sup>3</sup>, SMEs account for 10% of turnover generated in the UK manufacturing sector, representing 5% of the whole UK manufacturing sector and a share of 9% employment (Business Population Estimates, 2016). They form a total of 1,922,950 firms in private sector with the employment size of 0-249 across all 96 manufacturing divisions drawn from the UK SIC 2007 classification. While, the total number of large manufacturing firms in the same classification with the employment size of greater than 250 reaches 745,855. Therefore, it is estimated that the population of the five manufacturing divisions targeted in this research comprises of 11,890 SMEs and 10,480 large manufacturing firms<sup>4</sup>.

Using the FAME database, it was identified that of the 74,211 firms under the UK SIC (2007) classification in the five manufacturing firms (Braunscheidel and Suresh, 2009), there were only 29,570 firms with complete information on their SIC divisions, out of which only 28,536 firms were private. Applying additional filter to identify the number of SMEs and large firms, it produced 3,490 and 471 SMEs and large manufacturing firms with complete information on their number of employees, respectively. Table 5.3 illustrates the proportion of the sample size (valid responses), sample frame drawn from the FAME database and an estimation of the population size. It also presents the frequency of SMEs and large

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<sup>3</sup> The Business Population Estimates are used extensively by the government, academics, etc. “to analyse the scale, structure and significance of the total business population in the UK and to monitor change over time” (Wright, 2018, p.15). “This source is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated” (Wright, 2018, p.16). The licence is available to view at <http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>.

<sup>4</sup> These figures are adopted from Office for National Statistics (ONS) which is “responsible for collecting and publishing statistics related to the economy, population and society at national, regional and local levels” (ONS, n.d).

manufacturing firms participated in the current study. Out of the total of 215 respondents, there were 180 SMEs (85%), and 32 large manufacturing firms (15%), and 3 cases did not indicate the number of their employees. Therefore, the responses are dominated by the SMEs category which is consistent with their important and dominant position in the UK manufacturing economy. This consistency also exists in the sample frame of 3,961 firms, indicating the response rates of 5.15% and 6.8% for SMEs and large firms, respectively, showing that large organisations had a slightly higher response rate than that of SMEs. This suggests that despite their small proportion compared to SMEs, large firms appeared to be more willing to share knowledge possibly because they continuously seek for ways to benchmark against their competitors.

*Table 5.3. The Proportion of the Sample Frame Compared to the Population of the Five UK Manufacturing Sectors-SMEs and Large Firms*

Firm Size	Sample Size		Sample Frame Drawn from the FAME		Population Size (private sector)	
	Frequency	Valid Percent	Frequency	Valid Percent	Frequency	Valid Percent
<b>0 through 249 employees (SMEs)</b>	180	85	3,490	88	11,890	54
<b>&gt; 250 employees (Large firms)</b>	32	15	471	12	10,480	46
<b>Total</b>	213	100.0	3,961	100.0	22,370	100.0
<b>Missing</b>	3					
<b>Total</b>	215					

*Note: The definition of SMEs and large organisations are adopted from Department for Business, Energy & Industrial Strategy (Business Population Estimates, 2016)*

The large difference between the population and the sample frame shown in Table 5.3 is due to several reasons. It is argued that many SMEs are normally reluctant to supply detailed information about their firms data (Fletcher et al., 2013). Moreover, after contacting an officer in ONS (Office for National Statistics), the researcher was informed that one of the main reasons for such a difference is because the data in ONS' s report is taken from the Inter Departmental Business Register (IDBR) and that only contains businesses registered for VAT and /or PAYE (Pay as You Earn). So, there are a large number of very small businesses that fall below these thresholds. It was also mentioned that ONS data include all legal statuses, thus sole proprietors, partnerships, etc. are included in these data. However, the FAME only include data on corporate businesses. Despite this inconsistency, the FAME was found to be the only database providing access to the UK universities for academic uses, and is considered reliable as it has been repeatedly used by many scholars. It also provides access to a large number of organisations in the UK and Irish firms key person contact details without which it would not be possible. This limitation is also pointed out by Department for Business, Energy & Industrial Strategy that there is no single database available which provides access to all the UK private sector organisations (Business Population Estimates, 2016). This, however, does

not seem to represent a problem in the sample as Saunders et al. (2012) argue that it is rare to obtain a sample that well-represents the target population.

### 5.3.Descriptive Characteristics of the Data

The following sections report some basic features of the data set containing 215 valid responses. The aim is to summarise the initial observation made in the sample and provide the demographics of individuals involved in the study. The initial description of the data is broken down into the following sub-sections to demonstrate the basic descriptive characteristics of the data obtained:

1. Operational size of the firms based on their average sales revenue per annum (turnover size)
2. Firms distribution by industry type
3. The main strategic position of the firms in the supply chain (OEM, Tier 1 supplier, Tier 2 supplier, etc.)
4. Demographics on the position of the respondents
5. Demographics on the adopted production strategy
6. The functional areas the respondents operate in

#### 5.3.1. Operational Size of the Firms: Turnover Size

Table 5.4 represents a breakdown of firms' size in terms of 2016 turnover band. The sample contains a large proportion of firms who indicated that have annual sales greater than £1000k. Interestingly, SMEs accounted for a reasonably large ratio suggesting their growing contribution to the UK manufacturing sector turnover (fsb Experts in BusinessBusiness, n.d.). A histogram with frequencies, which is illustrated in Figure 5.4, was also created, showing that most of the participating firms have fallen in the last four turnover bands. This large contribution was also analysed using a crosstab analysis which could be found in Appendix 5.1.

*Table 5.4. Analysis of the Frequency of the UK Manufacturing Sectors in Each Turnover Size Band (Turnover Size Bands are Adopted from Bardhan and Pattnaik (2016))*

Turnover Size Band	Frequency	Percent
Turnover between 0-49k	1	0.5
Turnover between 50k-99k	1	0.5
Turnover between 100k-249k	3	1.4
Turnover between 250k-499k	4	1.9
Turnover between 500k-999k	9	4.2
Turnover between 1000k-1999k	17	7.9
Turnover between 2000k-4999k	52	24.2
Turnover between 5000k-9999k	45	20.9
Turnover between 10000k-49999k	52	24.2
Turnover greater than 50000k+	24	11.2
Total	208	96.7
Missing	7	3.3
Total	215	100.0

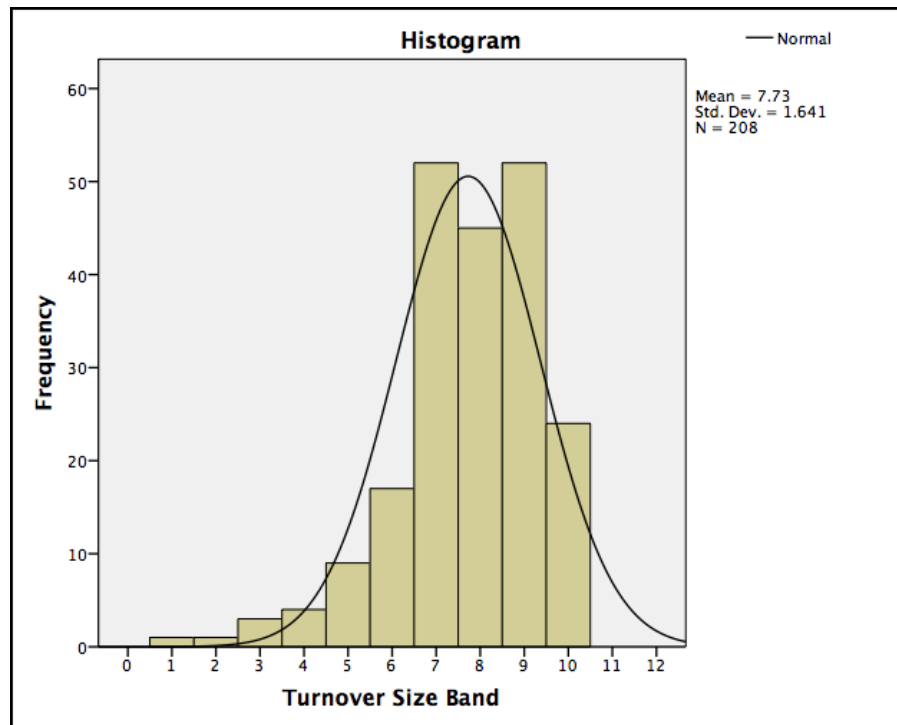


Figure 5.4. Analysis of the Manufacturing Firms by Their Turnover Size Band

### 5.3.2. Distribution of the Firms by Industry Type

As it was already stated the target population is SMEs and large manufacturing firms characterised as high-, or medium-tech according to OECD definition. They include manufacture of computer, electronic and optical products, manufacture of electrical equipment, manufacture of machinery and equipment n.e.c, manufacture of motor vehicles, trailers and semi-trailers, and manufacture of other transport equipment. The target sample of these five classifications was obtained from the FAME database. Table 5.5 shows the spread of the 215 organisations across these five manufacturing sectors.

Table 5.5. Spread of Participating Firms Across the Five Manufacturing Sectors Adopted from SIC 2007 Classifications

Manufacturing Industry Type	Frequency	Percent
Industry Type 1: Manufacture of computer, electronic and optical products	58	27
Industry Type 2: Manufacture of electrical equipment	48	22.3
Industry Type 3: Manufacture of machinery and equipment n.e.c.	73	34
Industry Type 4: Manufacture of motor vehicles, trailers and semi-trailers	8	3.7
Industry Type 5: Manufacture of other transport equipment	22	10.2
Other	6	2.8
<b>Total</b>	<b>215</b>	<b>100.0</b>

It is evident among the list that the manufacture of machinery and equipment n.e.c is the most dominant sector with 73 participants accounting for 34% of the sample size. A very small proportion of the firms (i.e. 2.8%) were identified to operate in other manufacturing

sectors including manufacture of other fabricated metal products, manufacture of other taps and valves, and manufacture of tools and prototype vehicles (as indicated by participants). Since this research seeks to investigate the research hypotheses across the sample firms in general, the researcher does not aim to confine the analysis to any specific sector in particular. Moreover, a series of t-tests were also conducted to identify if there is any difference between the sectors. Yet, no significance difference was found, suggesting that running the main analysis on each sector separately is not needed. This will be discussed later in the main analysis section.

### 5.3.3. The Main Strategic Position of the Firms in the Supply Chain (SC)

Data were collected from both OEMs and suppliers (first tier and second tier) to obtain alternate point of views and different perspectives on the subject under study. There were 41.7% and 52.3% suppliers and OEMs, respectively, see Table 5.6. Moreover, 6% of the firms indicated that they operate as both a supplier and OEM depending on their specific products. These firms mainly consist of multiple business units working for the same corporate company and are located in multiple locations across the UK. The sample is treated as homogenous as no difference was identified between the two groups in terms of BPO, II as well as the level of PM.

*Table 5.6. Participating Firms Position in the Supply Chain*

<b>Firms Position in the Supply Chain</b>	<b>Frequency</b>	<b>Percent</b>
<b>Supplier (Tier 1 supplier, Tier 2 supplier)</b>	90	41.9
<b>OEM</b>	112	52.1
<b>Both</b>	13	6.0
<b>Total</b>	215	100.0

### 5.3.4. Demographics of the Respondents by their Position

Top and senior management were approached who were thought to possess relevant knowledge about the key business processes as well as the operations across the key functional areas. To avoid the responses being biased towards a specific function, respondents from across multiple functions were targeted. According to the values represented in Table 5.7. 51% of the respondents held senior level management position, while 48% were operational and business level managers (line managers). Although, attempts were made to aim the management level staff, a very small proportion of the positions (1%) fell outside the scope of the targeted respondents. They include data scientist, consultant, and owner. Since all these respondents did pass through the screening questions in the beginning of the questionnaire, they are all deemed qualified to have the appropriate knowledge for being considered in this study. A balanced response rate was obtained between upper-echelon management level and



operational/business level managers, suggesting that there is a level of diversity among opinions varying from upper echelons to lower level of management. This represents heterogeneous characteristic of the respondents with different level of business involvement and a breadth of knowledge, allowing for a broader assessment of the issues under study (Naranjo-Gil et al., 2008).

The combination of the two levels of management is considered to be instrumental in obtaining a wide range of perspectives and also appraising the level of consistency between their views. Operational and business level managers are more likely to be involved in more extensive interactions with other employees across an organisation (Chen and Bliese, 2002), thereby considered to possess appropriate knowledge regarding the underlying research questions. Thus, they could contribute greatly in developing the understanding of the proposed research relationships. On the other hand, it is argued that higher management level is a strong predictor of “collective efficacy” in a firm (Chen and Bliese, 2002, p.549), hence, their perspective could have a great implication for examining the theoretical framework. Moreover, the issue of external validity could also be addressed to some extent by including heterogeneous sample including both senior and operational level managers (Ahire and Golhar, 1996).

*Table 5.7. Demographics on the Position of the Respondents*

<b>Position</b>	<b>Frequency</b>	<b>Percent</b>
<b>Senior Level Management</b> (e.g. CEO, COO, General Manager, Managing Director, Non-Executive Director)	109	51
<b>Operational/Business level Managers</b> (e.g. Brand Manager, Chairman, Commercial Director)	103	48
<b>Other</b> (data scientist, consultant, and owner)	3	1

*Note: For a full list of positions please refer to Appendix 5.2*

### **5.3.5. Demographics of the Parts Production Strategy Adopted by the Respondents**

Table 5.8 presents the descriptive statistics of the parts production strategy adopted by the sample frame. Parts productions strategy was divided into four categories of ‘*the manufacture of familiar product in low volume*’, ‘*the manufacture of familiar products in high volume*’, ‘*the manufacture of new product in low volume*’, ‘*the manufacture of new products in high volume*’. The question was designed in a way which allowed the respondents to choose more than one answer. A frequency analysis was conducted, and the percentages were computed on the total sample size of 215 cases. The multiplicity of answers resulted in the total frequency exceeding 215. Report of this section revealed that the most used production strategy is ‘*the manufacture of familiar product in low volume*, (i.e. 163 cases), and almost 48% of the participating firms is taking this approach. The second popular strategy is ‘*the manufacture of new products in low volume*’ which accounted for 27.8% of the sample respondents. Similarly, other strategies in order of frequency are ‘*the manufacture of familiar*

*products in high volume*' (16.6%) and *'the manufacture of new products in high volume'* (7.4%).

*Table 5.8. Demographics of the Parts Production Strategy Adopted by the Respondents*

<b>Parts Production Strategy</b>	<b>Frequency</b>	<b>Percent</b>
The manufacture of familiar products in low volume	163	48.2
The manufacture of familiar products in high volume	56	16.6
The manufacture of new products in low volume	94	27.8
The manufacture of new products in high volume	25	7.4

### **5.3.6. Demographics of the Respondents by their Functional Areas**

An examination of the sample frame showed heterogeneity with respect to the participants functional background (Bantel and Jackson, 1989). A frequency analysis revealed that the majority of respondents are involved in cross-functional activities, serving multiple functions. As illustrated in Table 5.9, a total of 137 (20.3%) and 116 (17.2%) respondents indicated that they were involved in sales & marketing and R&D activities, respectively. The next largest proportion of responses is associated with production function with 15.7%, followed by after sales services (12.6%), and then finance, purchasing and logistics, representing 10.7%, 10.1% and 6.5% of the total responses, respectively. The remaining 7.1% refers to other functions which were not listed among the answer choices, including customer service, data engineering, product quality, supply chain, etc.

*Table 5.9. Demographics of the Participants Functional Areas*

<b>Functional Area</b>	<b>Responses</b>		<b>Percent of Cases</b>
	<b>Frequency</b>	<b>Percent</b>	
<b>Research &amp; Development (R&amp;D)</b>	116	17.2%	54.0%
<b>Sales &amp; Marketing</b>	137	20.3%	63.7%
<b>Logistics</b>	44	6.5%	20.5%
<b>Finance</b>	72	10.7%	33.5%
<b>Purchasing</b>	68	10.1%	31.6%
<b>Production</b>	106	15.7%	49.3%
<b>After Sales Services</b>	85	12.6%	39.5%
<b>Other</b> (e.g. Environmental Health and Safety, Automation, Systems and Administration, Legislation, Product Quality, HR, Operations, IT, Supply Chain, Design-applications, Manufacturing Engineering, Data Engineering, Customer Service)	48	7.1%	22.3%
<b>Total</b>	676	100.0%	314.4%

### **5.4.Confirmatory Factor Analysis (CFA): BPO and PM Constructs**

As opposed to exploratory factor analysis (EFA) which is mainly used to uncover the underlying structure of variables when there is no pre-developed factor structure, confirmatory factor analysis (CFA) is employed to assess the pre-developed relationship between the latent constructs and their observed variables, thus verifying the factor structure. Given that this

research has used some pre-developed scales with known factors structure for BPO and PM, CFA is conducted to assess their factors reliability and validity. Theory has repeatedly considered a five-factor structure for BPO measurement model (Brown, 2015). While PM is suggested to be a unidimensional variable measured by five individual items (Antonio et al., 2009).

Some assumptions need to be met in the data set prior to conducting CFA, namely *conceptual and statistical assumptions*. In terms of *conceptual assumptions* two issues need to be assessed. First, there should be some underlying structure existing in the variables set. Since the variables are all adopted or/and adapted from pre-developed and validated scales, the first conceptual assumption is met, confirming the underlying structure among the variables. In addition, conceptual assumption is concerned with the sample homogeneity. Having obtained a sample of 90 suppliers and 112 OEMs the sample is considered to be homogenous as the two groups showed no difference with regards to any given items, meaning that the factor structure and correlations will remain the same when running CFA with both groups combined as well as each group individually (Hair et al., 2014).

The *statistical assumptions* which are overriding concerns in any research are as follows:

- Sample size
- Items normality check
- Checking for univariate outliers

#### **5.4.1. Sample size**

One of the key factors in CFA investigation is an adequate sample size required to support “an acceptable level of precision and statistical power of the model’s parameter estimates, as well as reliable indices of overall fit” (Brown, 2015, p.380). The result of CFA is largely affected by small sample sizes, which could result in falsely rejecting the measurement model. Factor analysis is suggested to be suitable for sample size greater than 100 observations. A 10:1 ratio is suggested to be a satisfactory sample size as a rule of thumb. Therefore, having seven key variables in this research the sample size of 215 valid responses is considered acceptable (Hair et al., 2014), as such the suitability of sample for factor analysis is confirmed (Brown, 2015).

#### **5.4.2. Items Normality Check**

Prior to CFA, normality test is run to check if data are modelled for normal distribution. A relatively large sample size (> 30 or 40) is argued to be immune to normality violation, meaning that parametric techniques can still be used in this situation. Therefore,

statistical tests could still detect significant relationships even with a small departure from normality assumption. Given the sample size in this research ( $> 200$ ), an acceptable range of  $\pm 2.58$  for both skewness and kurtosis with  $p < 0.01$  is applied for normality tests (Ghasemi and Zahediasl, 2012). While, skewness and kurtosis examination is argued to be a good indicator for assessing normality, to make a reliable judgment further information is suggested to be obtained through the use of diagrams and normality tests (Ebrahimi, 2015).

Each item was tested individually by checking the significant tests for kurtosis and skewness, using SPSS. The results identified that the values of kurtosis and skewness were mostly within the acceptable range with very few items slightly violated the normality assumption which is not expected to cause any major problem in the main analyses. On this account, all the items are considered to be reasonably normal (Tabachnick and Fidell, 2013). In addition, a series of descriptive statistics were derived for each item. The result of the test for item PM2 (used for product modularity (PM) measurement model) is presented in Table 5.10, and the same applies to other items. The table shows the 5% trimmed mean being 4.6784 is not significantly different from the original mean, i.e. 4.6106, with the difference being only 0.068. The test was conducted for all the other items and the examination revealed that the largest difference was 0.1, meaning that the extreme values in the dataset do not have any major impact on the mean (Dancey and Reidy, 2014).

*Table 5.10. Descriptive Statistics for Item PM2*

			Statistic	Std. Error
PM2	Mean		4.6106	0.12790
	95% Confidence Interval for Mean	Lower Bound	4.3585	
		Upper Bound	4.8627	
	5% Trimmed Mean		4.6784	
	Median		5.0000	
	Variance		3.517	
	Std. Deviation		1.87539	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-0.649	0.166
	Kurtosis		-0.869	0.330

The shape of the histogram graphs was also observed to check the items normal distribution (Tabachnick and Fidell, 2013). Figure 5.5 illustrates item PM2 is reasonably normal. The same applied to all other items which were observed to follow approximately normal distributions.

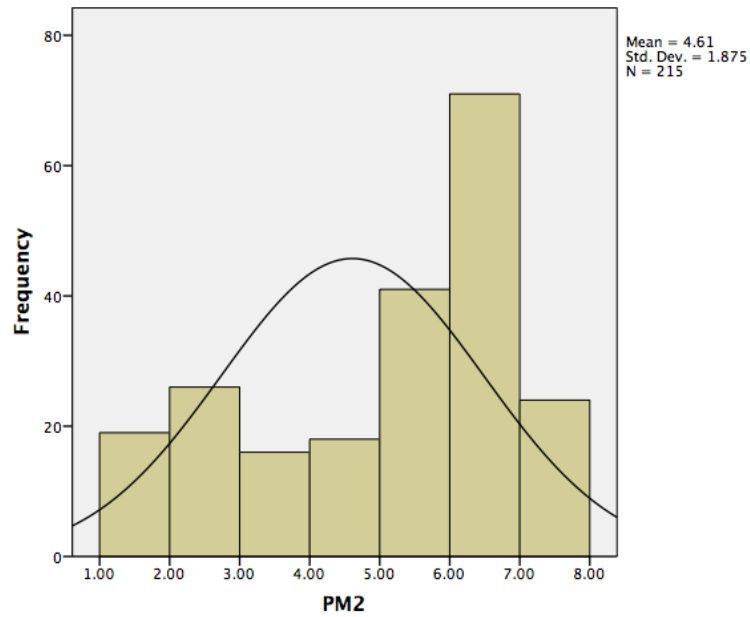


Figure 5.5. Item PM2 Normal Distribution

To further support the items are reasonably normally distributed by visual check a normal Q-Q plot was also produced for each item. Q-Q plot allows a researcher to compare the observed dataset with the expected values, i.e. normal distribution. As it is illustrated in Figure 5.6 the normal distribution assumption seems to be reasonably plausible, with data points forming a roughly straight line for item PM2. Similar results were also obtained for other items.

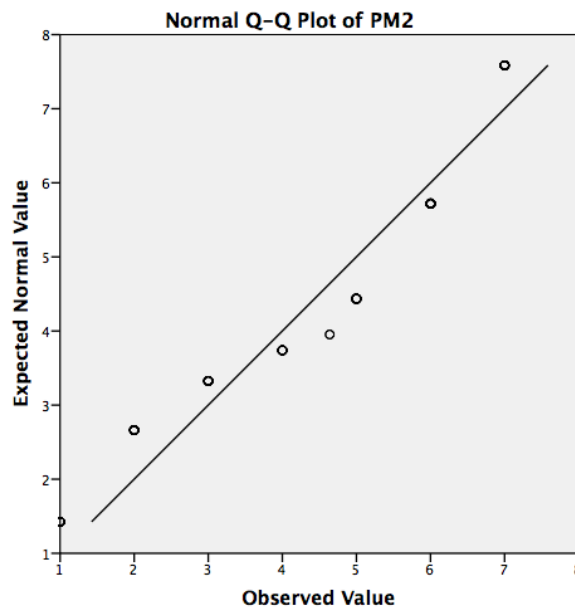


Figure 5.6. Q-Q Plot of Item PM2

Figure 5.7 represents the detrended normal Q-Q plot which is used to observe the direction and magnitude of deviation of the data points observed in the dataset from the normal distribution (i.e. horizontal line). This is evident that this deviation is not following any pattern and the observed values are all clustered around the zero line, confirming the normality of item PM2. The same graph was produced for all other items and no specific pattern was observed. Therefore, the normality of all items is confirmed.

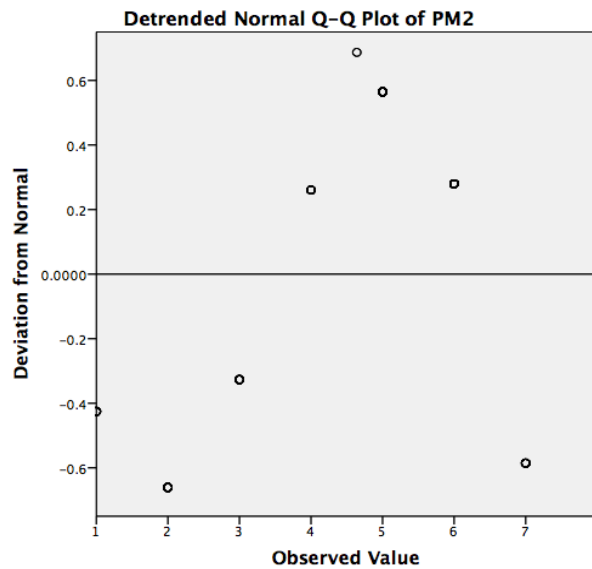


Figure 5.7. Detrended Normal Q-Q Plot for Item PM2

#### 5.4.3. Check for Univariate Outliers

An outlier is an extreme value that would distort statistics if not treated prior to data analysis, since it could lead to Type I and Type II errors, thus affecting the results generalisability. Therefore, it is critical to closely investigate the nature of outliers and treat them accordingly. The graphical methods suggested to identify outliers are histogram, box plot, normal Q-Q plot, and detrended Q-Q plot (Tabachnick and Fidell, 2013). Outliers can be treated by either deleting the case or constraining “the outliers to a maximum (or minimum) value” (Mat Roni, 2014, p.9). Hair et al. (2014) suggested that outlier should be retained if it is within the normal range of dataset and there is no evidence proving that the outlier is drawn inadvertently from a different population. By the very nature of the variables being Likert-type, which has a narrow spectrum ranging from 1 to 7, discarding cases appears to be imprudent as the responses are at either the high or low end of this range. It is also argued that extreme values within the Likert scale range, i.e. 1 to 7, are not representative of outliers since Likert scale has floor and ceiling (Gaskin, 2017). In line with this, Broeck et al. (2005, p.967) argue that “many outliers are detected by perceived nonconformity with prior expectations,

based on investigator's expectation". Based on these arguments, the extreme responses obtained from the respondents are not contradicting with the researcher's expectations and are within the set range of 1-7, thus are not treated as outliers.

One of the possible reasons for the existence of extreme responses has been cited as the presence of individuals who are from the intended population but have a slightly different perspective on a given question (Tabachnick and Fidell, 2013). This could also be due to a minority of respondents who carelessly answer the questions by giving random responses. After careful examination and screening of the dataset, it was identified that the former reason appears to be the most possible cause of extreme values. The 5% trimmed mean values examined earlier showed no huge difference with the original mean of each item, indicating that the results would not be significantly influenced by the extreme cases. Besides, each case was individually inspected again to identify any suspicious behaviour in their answers. No suspicious behaviour was found, therefore extreme cases (or outliers) are not an issue in this research.

The examination of the three statistical assumptions indicated that the dataset is appropriate for conducting factor analysis, allowing the researcher to proceed to carry out the CFA investigation. The following section will explain the procedure to conduct CFA and EFA. The results of each test are then examined, followed by the provision of the final measurement model for each latent variable (i.e. BPO, PM, and II).

### **5.5.Factor Analysis**

Factor analysis is performed to check the reliability and validity of the questionnaire items while testing the model fit of the measurement model for the three latent variables. Figure 5.8 outlines the tests undertaken to establish the measurement models. First CFA was conducted for BPO and PM and their validity and reliability were examined. This was followed by the administration of EFA and CFA for II. EFA is not conducted for BPO and PM since the conceptual model underlying these two constructs is grounded on firm definitions in the existing literature (as argued earlier). Thus, their five- and one-factor constructs, respectively, are deemed to provide a comprehensive breakdown of their definition (Reijers, 2006, Antonio et al., 2009).

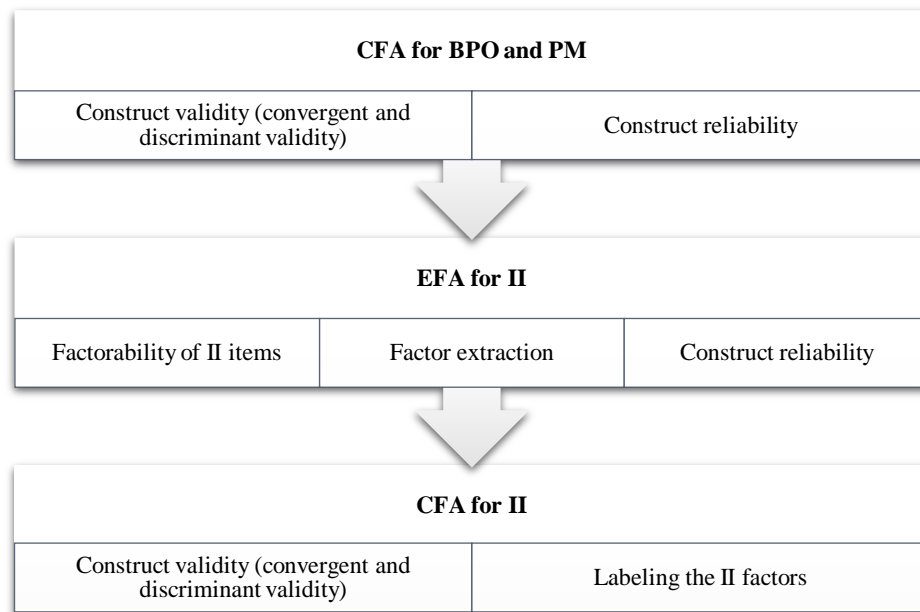


Figure 5.8. Summary of the Tests Undertaken for Factor Analysis

### 5.5.1. CFA for BPO

Drawing on the five factors of PJ, PV, PMM, PS and CFPVB, CFA was conducted for BPO using AMOS<sup>5</sup> (Analysis of a Moment Structures). AMOS is an added SPSS module allowing for CFA analysis, Structural Equation Modelling (SEM) test, as well as path analysis. Maximum likelihood (ML) estimation method was used “to find [CFA] parameter[s] values [such as factors variance, error covariances, etc.] that make the observed data most likely” (Brown, 2006, p.73). The model goodness-of-fit could be evaluated using a wide range of fit indicators (Schaufeli et al., 2002).  $\chi^2$  test is the most common significant test used to assess goodness-of-fit. An insignificant p-value suggests that model fits the data (Schaufeli et al., 2002). However, it has received a great deal of criticisms as not being an adequate fit criterion per se due to its sensitivity to a large sample size (in this research 215 cases), resulting in significant p-value. To mitigate the risk of this sensitivity (Byrne, 2016) and instil the confidence in effectively assessing the models fit some highly recommended alternative fit indices are incorporated with  $\chi^2$  test (e.g. Bentler, 1990, Hair et al., 2014, Byrne, 2016). They include the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), Goodness-of Fit (GFI) statistics and Standardised Root Mean Square Root (SRMR) (Schaufeli et al., 2002).

<sup>5</sup> “This approach includes [...] many well-known conventional techniques, including the general linear model and common factor analysis” (Arbuckle, 2008; p.1). Amos can also be used to run exploratory and confirmatory factor analysis (Arbuckle, 2008, Shek and Yu, 2014)



RMSEA index is a measure of assessing the difference between the predicated and the observed covariance matrix per degree of freedom (df). RMSEA values below the 0.08 threshold imply an acceptable model fit (Browne and Cudeck, 1993). CFI is a measure used to avoid issues of sample size, assuming that there is no correlation between the latent variables. CFI greater than 0.9 is recommended as a good fit (Hooper et al., 2008). GFI specifies the model fit through approximating the amount of variance explained by the expected population covariance and is not recommended for the models where df is greater than sample size. However, this does not apply to this research since sample size is larger than df ( $215 > 107$ ). GFI value greater than 0.9 is considered a very good fit. SRMR is an absolute fit index measuring the standardised discrepancy between the estimated and observed correlations (Hooper et al., 2008). SRMR is used as a better alternative to RMR (Root Mean Square Residual) in this research due to the use of Likert scales. It is argued that in a questionnaire with items containing varying levels the interpretation of RMR output involves some difficulties (Kline, 2010). An SRMR value below the 0.05 threshold is considered a very good fit.

The results of CFA analysis revealed a poor fit of BPO model, suggesting the need to make the necessary adjustments through combined diagnostics approach, as recommended by Hair et al. (2014). This was performed through removing items highly regressed across other factors (regressions greater than 0.4) as were recommended by modification indices in AMOS output. Modification indices provide an empirical estimate of any potential cross-loadings between variables (Hair et al., 2014). In addition, some of the error terms were co-varied using these indices to further improve the overall fit of the measurement model. This resulted in a five-factor measurement model in which *Chi-square* ( $X^2$ ) = 181.224,  $p=0.0001$ ,  $df=107$ ,  $X^2/df=1.694$  ( $<3$  very good fit),  $RMSEA=0.057$ ,  $CFI=0.968$ ,  $GFI=0.910$ , and  $SRMR= 0.0438$  which indicate acceptable model fits.

### 5.5.2. CFA for PM

The results of CFA conducted for the PM construct containing 5 items in its measurement model indicated a poor model fit, suggesting to remove item PM1 with a standardised regression weight of less than 0.5 (Hair et al., 2014). This data reduction process yielded excellent results, providing evidence of a great model fit ( $X^2 = 2.347$ ,  $df = 2$ ,  $p = 0.309$  (which is not significant at the level of 0.005),  $X^2/df = 1.173$  ( $<3$ ),  $RMSEA= 0.028$ ,  $CFI= 0.998$ ,  $GFI=0.995$ , and  $SRMR= 0.019$ ).

After improving the model fits the CFA revealed a very good fit in both BPO and PM measurement models, indicating that further models examination could be proceeded. The following sections examine multicollinearity and construct validity, i.e. discriminant and convergent validity, followed by the evaluation of the constructs reliability.

### **5.5.3. Multicollinearity**

Multicollinearity is a common problem in regression analysis and refers to the problem of high dependency/correlation among independent variables estimating a dependent variable in MRA. The presence of multicollinearity could distort the estimates of regression coefficients in MRA if it is not removed. The simplest way to detect it is through the examination of correlation matrix for the independent variables in which any correlation greater than 0.9 is the indication of multicollinearity (Hair et al., 2014). While, correlation matrix provides an easy identification of collinearity, lack of high correlation is not a firm indication of the absence of multicollinearity. Thus, further examination should be done through assessing the value of Variance Inflation Factor (VIF). VIF measures the amount of inflated variance in a measurement model among independent variables (Hair et al., 2014).

In order to identify multicollinearity, the correlation matrix was first generated for the five BPO factors and no high correlation was identified between the variables. Moreover, VIF value was assessed for each factor and the results revealed that all the values were below the desirable target value of 10 (as a rule of thumb) (Hair et al., 2014, Byrne, 2016). Thus, multicollinearity is not an issue for the BPO construct. Furthermore, multicollinearity does not pose any problem with one-dimensional constructs, thereby it does not affect PM measured as a one-factor construct.

### **5.5.4. Construct Validity: Convergent and Discriminant Validity**

As presented in Chapter Four, construct validity is defined as the extent to which a scale designed to measure a theoretical latent construct could actually measure it. It is known under two categorisations of convergent and discriminant validity. In testing for construct validity of a measurement model CFA is used to provide a robust evidence that the true scores in a target population is reflected through the measures obtained from the sample (Hair et al., 2014).

#### **5.5.4.1. BPO and PM Convergent Validity and Reliability**

Convergent validity determines the extent to which the items measuring the same construct are truly associated. It is estimated through three key indicators namely, factor loadings, Average Variance Extracted (AVE), and items reliability. A high standardised factor loading (greater than 0.5, which is statistically significant, as Hair et al. 2014 indicated) is an indication of convergent validity. In addition, AVE should be greater than 0.5 to suggest an adequate convergent validity. As for a construct reliability, coefficient alpha determines the extent of internal consistency among a set of items. As a rule of thumb alpha greater than 0.7

is desirable and indicative of a high reliability. While a value between 0.6 and 0.7 is also acceptable (Hair et al., 2014). Table 5.11 presents the items deleted to refine the BPO and PM factor structure for the purpose of improving validity, reliability as well as reducing measurement error of the variables (Hair et al., 2014).

*Table 5.11. Variables Deleted for Factor Structure Refinement (BPO and PM Constructs)*

<i>Criteria</i>	<i>Deleted Variables</i>	<i>No of Variables</i>
	<b>BPO Construct</b>	
<b>Non-significant factor loadings (less than 0.5)</b>	PJ1 (Jobs are usually multidimensional and not just simple tasks in these processes) PJ2 (Jobs include frequent problem solving in these processes) PJ3 (Employees are constantly learning new things on the jobs which are involved in these processes) PV1 (Employees often view the business as a series of linked processes)	4
<b>Significant cross-loadings</b>	PJ4 (A process owner/manager, who takes the overall responsibility and authority of the process, has been assigned to each key process) PJ5 (Process owners/managers are experienced leaders/managers) PJ8 (There is at least one senior executive who has taken leadership of and responsibility for the key business processes) PV2 (Process terms (input, output, process and process owners) are used in the conversation made between individuals across the organisation) PV3 (The key business processes are defined and documented by using the terms "inputs, outputs, to and from our customers") PV4 (The key business processes are sufficiently defined and shared with employees by managers so that most employees know how they work) PV5 (There is a 'system view' in place (i.e. the entire process is managed)) PMM5 (Resources (e.g. people, expenses, and other capital) are allocated based on the needs of these key business processes) PMM6 (There are feedback loops between functions for ongoing learning and improvements in the key business processes) PS5 (The organisation has functional areas, but employees regularly participate in cross-functional teams) CFPVB1 (The customer is central to the organisation's business model) CFPVB2 (Employees pay attention to the customer's needs in their jobs which are involved in the key business processes) CFPVB6 (Customer satisfaction is used on a regular basis) CFPVB7 (Customer feedback is used intensively to improve product quality)	14
	<b>PM Construct</b>	
<b>Non-significant factor loading (less than 0.5)</b>	PM1 (Products can be decomposed into separate modules)	1

An examination of the five-factor BPO model was performed using AMOS, revealing the requirement for deleting four items (i.e. PJ1, PJ2, PJ3, PV1, see Table 5.11) with factor loadings below the desired cut of point of 0.5. The elimination of these items resulted in a high convergent validity where all the factor loadings were significant and greater than 0.5. Having computed the AVE for each BPO factor, it was found that all the mean variances were above the 0.5 threshold. Constructs reliability values were also well above the desired 0.7 target value, meaning that all the five BPO factors represent the same latent construct. Taken together, convergent validity and reliability are supported for the BPO measurement model (Hair et al. 2014). The results of convergent validity and reliability tests for the five BPO factors are illustrated in Table 5.12.

Table 5.12. Convergent Validity and Reliability Results for the BPO Factors

Variables	CR (Construct Reliability)	AVE
PS	0.857	0.602
PJ	0.829	0.619
PV	0.886	0.723
PMM	0.917	0.735
CFPVB	0.816	0.597

The three indicators were also calculated for the one-factor PM construct to check the convergent validity and reliability. The results showed except only one item with non-significant factor loading (i.e. PM1, see Table 5.11) all the factor loadings were well above the suggested 0.5 and significant. The AVE also fell above the 0.5 threshold, i.e. 0.580. Furthermore, the construct reliability being 0.754 suggested an adequate reliability of the items measuring the PM construct. Thus, the results provided evidence of high convergent validity and reliability for PM measurement model after the deletion of PM1,(see Table 5.13).

Table 5.13. Convergent Validity and Reliability Results for the PM Construct

Construct	CR (Construct Reliability)	AVE
PM	0.754	0.580

#### 5.5.4.2. BPO Discriminant Validity

Discriminant validity assessing items uniqueness identifies the extent to which two measures/items that are not supposed to be related are in fact unrelated (Ofori-Amanfo, 2014). Conventionally, it is established through comparing the AVE values with the squared inter-construct correlations for each factor. In doing so, discriminant validity is confirmed if this comparison results in the AVE greater than the squared correlations between the items of the same construct (i.e. BPO) (Hair et al., 2014). The examination of the BPO five-factor model revealed the requirement for removing fourteen items with significant cross-loadings. Thus, these items presented in Table 5.11 were deleted from the model. The resultant measurement model met the criteria for discriminant validity which is shown in Table 5.14. It is evident that all the AVE estimates from Table 5.12 are greater than the “corresponding inter-construct squared correlation estimates” in Table 5.14 (Hair et al., 2014: p.633) which provide adequate evidence supporting the factors discriminant validity.

Table 5.14. BPO Five-Factor Model Discriminant Validity Results

	PS	PJ	PV	PMM	CFPVB
PS	<b>0.776</b>	0.516	0.528	0.312	0.508
PJ	0.719	<b>0.787</b>	0.570	0.251	0.322
PV	0.727	0.755	<b>0.850</b>	0.418	0.342
PMM	0.559	0.501	0.647	<b>0.857</b>	0.256
CFPVB	0.713	0.568	0.585	0.506	<b>0.773</b>

*Note: Values below the diagonal are the inter-construct correlation estimates, the diagonal values are the construct variance, and the elements above the diagonal are the inter-constructs squared correlations*

### **5.5.5. EFA for II**

The underlying structure of the variables can be uncovered using EFA which allows to identify the number of distinct variables measured through a set of observed items (Fabrigar and Wegener, 2012). EFA is mainly performed for either theory development (the structure of the relationship between constructs) or data reduction (reducing the number of items into a smaller number of factors) (Fabrigar and Wegener, 2012). This research solely aims to carry out EFA for the purpose of data reduction in order to identify and isolate items with high factors loadings (Williams et al., 2010). While literature revealed that II multidimensionality has been broadly acknowledged, a clear indication of its factors structure is yet to be investigated, as discussed extensively in Chapter Two. Therefore, a series of statistical tests are conducted to recognise II factors, followed by establishing their consistency and reliability. Like CFA investigation, prior to performing EFA some assumptions need to be met in relation to sample size, linearity, normality, outliers and factorability of correlation matrix, which are examined in the following sections.

#### ***Sample Size***

As already discussed for CFA, factor analysis is suitable for sample size greater than 100. This research contains seven key constructs with the sample size of 215 valid response, confirming the suitability of sample for factor analysis based on the 1:10 ratio as a rule of thumb.

#### ***Linearity***

This assumption does not apply to this research dataset since the variables are ordinal. Factor analysis is suggested to be suitable for such scales which could be closely approximated to interval scales (Fabrigar and Wegener, 2012).

#### ***Normality***

The II items were assessed to check if they comply with a normal distribution. The same tests conducted for BPO and PM were applied to II and identified that all its associated items were reasonably normal.

#### ***Check for Outliers***

As discussed in the previous section, it is argued that extreme values within the Likert scale range, i.e. 1 to 7, are not representative of outliers since Likert scale has floor and ceiling (Gaskin, 2017). Therefore, since II items were measured using a seven-point Likert scale, extreme values are not treated as outliers.

### ***Factorability of Correlation Matrix***

As part of the EFA statistical assumptions, the appropriateness of the data should be evaluated for factor analysis through the examination of the correlation matrix. Some degree of multicollinearity is desirable, meaning that variables should be correlated to some extent for EFA to be appropriate (Hair et al., 2014). Thus, items with very low correlations (less than 0.3 and not significant) should be inspected in the dataset as they could pose problems in identifying the underlying structure of the factors (Hair et al., 2014). However, very high correlation (extreme multicollinearity) among the pair of variables is not in favour of factor analysis as one may fail to identify the unique contribution of each item to a factor (Fidel, 2009).

The II items correlation matrix was generated using SPSS, showing that all the correlations are significant at 0.01 level, with only a handful of correlations being below 0.3 which are considered negligible (see Appendix 5.3). This suggests that the minimum requirement is satisfied to proceed with the empirical investigation of the variables factorability (Hair et al., 2014). The overall significance of the correlation matrix was also assessed using Bartlett's Test of Sphericity. The result of this statistical test was significant at 0.0001 level, confirming the overall significance of the correlation matrix. Kaiser-Meyer-Olkin (KMO) test known as the measure of sampling adequacy (MSA) resulted in a KMO of 0.941 which is well above the acceptable value of 0.50. Taken together, the results of Bartlett's Test of Sphericity and KMO confirm the "factorability of the overall set of variables" (Hair et al., 2014: p.130). The results of Bartlett' test and KMO are exhibited in Table 5.15.

*Table 5.15. KMO and Bartlett's Test Results*

II	<b>Kaiser-Meyer-Olkin Measure (KMO) of Sampling Adequacy.</b>		0.941
	<b>Bartlett's Test of Sphericity</b>	<b>Approx. Chi-Square</b>	2781.427
	<b>df</b>		126
	<b>Sig.</b>		0.000

The above assessments showed the suitability of the data for EFA, leading this research to conduct factor analysis for grouping the items measuring the same constructs and at the same time distinct from other measures. Items were checked in terms of their item-to-total correlations (<0.4 for sample size greater than 200 is not desirable as suggested by Hair et al. (2014)) and identified all the II item-to-total correlations were above 0.4 (see Appendix 5.4). Thus, all the II items were retained for factor extraction.

#### **5.5.5.1. II Factor Extraction**

A principle components analysis (PCA) using varimax rotation was conducted on 17 items, and a two-factor structure was emerged for II latent variable (see Table 5.16). Varimax

rotation was used to maximise the amount of variance explained by the factors (Tabachnick and Fidell, 2013). All factor loadings were reported to be above the desired value of 0.5 (Hair et al., 2014). Items with significant cross-loadings (greater than 0.4) were inspected to identify the impact of their deletion on the factor loading results. Five items were identified including II1, II4, II5, II9, and II15, which are shown in Table 5.17.

*Table 5.16. The Factor Loading Matrix for the II Items*

<b>Rotated Factor Loading Matrix</b>			
	<b>II Component</b>		<b>Communalities</b>
	<b>1</b>	<b>2</b>	
<b>II12</b>	0.855		0.784
<b>II11</b>	0.841		0.792
<b>II14</b>	0.832		0.731
<b>II13</b>	0.804		0.713
<b>II10</b>	0.784		0.745
<b>II17</b>	0.776		0.701
<b>II16</b>	0.721		0.585
<b>II15</b>	0.701		0.658
<b>II4</b>		0.525	0.607
<b>II6</b>		0.819	0.692
<b>II7</b>		0.808	0.664
<b>II3</b>		0.730	0.673
<b>II2</b>		0.699	0.584
<b>II8</b>		0.678	0.577
<b>II1</b>		0.620	0.560
<b>II5</b>		0.588	0.584
<b>II9</b>		0.579	0.624

*Table 5.17. II Variables with Significant Cross-Loadings (SPSS Factor Extraction Output)*

<b>Criteria</b>	<b>II Variables</b>	<b>No of Variables</b>
<b>Significant cross-loadings (&gt; 0.4)</b>	II1 (Your organisation's functional areas/business units are jointly managed strategically) II4 (Functional teams are aware of each other's responsibilities) II5 (Functional teams have a common prioritisation of customers in case of supply shortages and how allocations will be made) II9 (Operational and tactical information is regularly exchanged between functional teams) II15 (Conduct joint planning to anticipate and resolve operational problems)	5

Each item was deleted individually and as a group with other four items and the loadings recalculated. The deletion of the items produced a lower total reliability (lower Cronbach's alpha). Thus, all the items were retained and multiple reliability tests were carried out to identify the items resulting in the highest reliability for the two factors. It was revealed that II15 reduces the reliability if it is loaded on factor 2, thus assigned to factor 1. The remaining problematic items were also loaded on both factors and they all resulted in higher reduction of reliability in factor 2 than factor 1, hence allocated to factor 2. The extraction of two factors was further confirmed by latent root criterion technique which is commonly used to identify the factors with eigenvalue greater than 1. As it is illustrated in Table 5.18 the test

resulted in two factors exceeding this threshold, explaining 66% of the cumulative variance percentage which is above the suggested target value of 60% (Hair et al., 2014).

*Table 5.18. II Total Variance Explained*

II Component	Total Variance Explained					
	Initial Eigenvalues			Rotation Sum of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
<b>1</b>	9.613	56.546	56.546	9.613	56.546	56.546
<b>2</b>	1.663	9.782	66.328	1.663	9.782	66.328
<b>3</b>	0.735	4.323	70.651			
<b>4</b>	0.650	3.821	74.472			
<b>5</b>	0.576	3.391	77.862			
<b>6</b>	0.497	2.922	80.784			

To further assess the number of factors extracted visually Scree Plot criterion was used, and it was revealed that only two factors have substantial amounts of common variance (eigenvalue greater than 1). Therefore, having done the three-stage assessment a two-factor structure was obtained for the II construct, which will be further explained in the following sections in relation to their underlying theoretical definition.

#### **5.5.5.2. II Reliability**

One of the most common measures, particularly in OM research (Forza, 2002), to test variables reliability is Cronbach's alpha ( $\alpha$ ) indicating the extent to which items selected to measure a construct are associated (Ofori-Amanfo, 2014). This was pioneered by Cronbach (1951) who developed reliability to measure scales internal consistency. Like validity, reliability is also a priori requirement for parametric analysis. (Tavakol and Dennick, 2011), and a Cronbach's alpha ( $\alpha$ ) equal to or greater than 0.7 is recommended as an indicator of a good reliability (Cronbach, 1951, Bland and Altman, 1997, Santos, 1999, Hair et al., 2014)

In order to determine II reliability  $\alpha$  was measured for each variable. Table 5.19 shows that both variables Cronbach's alphas are greater than the suggested value of 0.7. Additionally, the correlation between each item and the total of other items was examined through 'corrected item-total correlation' illustrated in Table 5.19, and it was found that this value was above the 0.4 threshold (suggested by Hair et al. (2014) for sample size > 200). This is indicative of high internal consistency, suggesting that all items are measuring their corresponding variable. The 'Cronbach's Alpha if Item Deleted' column also revealed that the deletion of each specific item would result in a smaller  $\alpha$ , thus all the items were retained. Therefore, the internal consistency analysis provides evidence confirming a high reliability for II multi-item measurement model. This result was expected since the items were selected from validated scales developed and tested by previous scholar.



Table 5.19. II Reliability Test (SPSS Output)

II Variables	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Composite Cronbach's Alpha ( $\alpha$ )
<b>Factor 1</b>			0.911
II1	0.675	0.902	
II2	0.689	0.902	
II3	0.764	0.896	
II4	0.693	0.902	
II5	0.694	0.901	
II6	0.698	0.901	
II7	0.655	0.905	
II8	0.691	0.902	
II9	0.714	0.900	
<b>Factor 2</b>			0.942
II10	0.822	0.933	
II11	0.855	0.930	
II12	0.833	0.932	
II13	0.795	0.935	
II14	0.806	0.934	
II15	0.759	0.937	
II16	0.695	0.941	
II17	0.788	0.935	

Note: The items definition is provided in Appendix 4.2

#### 5.5.5.3. Validation of II Factor Analysis

Following the factor analysis, the results need to be assessed in terms of the degree of generalisability. This involves the assessment of factors validity in the measurement model through CFA investigation in order to establish the model fit. CFA was conducted and the analysis resulted in a two-factor structure for II latent variable. The results demonstrated the need for model fit improvement. Similar to the CFA test presented for BPO, this was performed through removing items highly regressed across other factors (regressions greater than 0.4), drawing on the modification indices report. Using this report, some of the error terms were also co-varied to further improve the overall model fit. This yielded excellent results, providing evidence of an acceptable model fit ( $X^2 = 72.906$ ,  $df = 41$ ,  $p = 0.002$  (which is significant at the level of 0.005),  $X^2/df = 1.778$ ,  $RMSEA = 0.060$ ,  $CFI = 0.981$ ,  $GFI = 0.944$ , and  $SRMR = 0.0381$ ).

#### 5.5.5.4. II Convergent Validity

Convergent validity was checked for II construct using factor loadings and AVE indicators. An examination of the two-factor II construct reveals six items with high cross-loadings ( $> 0.4$ ), including II1, II4, II5, II7, II9, and II15 (see Table 5.20). After deletion of these items, all the factor loadings were identified to be above the 0.5 threshold. Moreover, AVE estimates for both factors were well above the 0.5 target value (see Table 5.21), supporting the construct convergent validity.

Table 5.20. Variables Deleted for Factor Structure Refinement (II Construct)

Criteria	Deleted Variables	No of Variables
Significant cross-loadings (> 0.4)	II1 (Your organisation's functional areas/business units are jointly managed strategically) II4 (Functional teams are aware of each other's responsibilities) II5 (Functional teams have a common prioritisation of customers in case of supply shortages and how allocations will be made) II7 (Performance metrics promote rational trade-offs among customer service and operational costs) II9 (Operational and tactical information is regularly exchanged between functional teams) II15 (Conduct joint planning to anticipate and resolve operational problems)	6

Table 5.21. Convergent Validity Results for the II Construct

	AVE
Factor 1	0.796
Factor 2	0.680

#### 5.5.5.5. II Discriminant Validity

II discriminant validity was also examined through comparing the AVE estimate for each factor with their corresponding squared inter-construct correlation estimates. The results, which are displayed in Table 5.22, showed that discriminant validity is not an issue for II measurement model since the squared inter-construct correlations are smaller than their corresponding AVE estimates from Table 5.20.

Table 5.22. II Construct Correlation Matrix (Discriminant Validity Results)

	Factor 1	Factor 2
Factor 1	<b>0.633</b>	0.488
Factor 2	0.699	<b>0.462</b>

#### 5.5.5.6. Labelling the II Extracted Factors

Although the process of labelling factors extracted from factor analysis involves a researcher subjective interpretation (Williams et al., 2010, Hair et al., 2014), it should be implemented in a way to ensure that labels reflect the theoretical definition of the factors (Pett et al., 2003, Williams et al., 2010). Hair et al (2014) argue that this process could be facilitated if the labels are selected rationally so that they conceptually fit the underlying nature of their related factors. While all significant factors are suggested to be considered in the procedure, those factors with the highest factor loadings should have a greater influence (Hair et al., 2014). It is also important to determine the nature of the second-order factors in terms of their relation to the first-order construct (i.e. II) (Petter et al., 2007, Ghobadi and D'Ambra, 2012). In other words, it should be recognised that whether II is caused by the two factors (i.e.

reflective factors by nature), or the factors form II (thus, are formative measures) (Diamantopoulos and Winklhofer, 2001, Ghobadi and D'Ambra, 2012).

In line with the recent conceptualisation of integration emerged from the literature (Chapter Two), this research argues that the four items of **factor 1** are the reflective measures representing the relational aspect of integration at an aggregate level. Likewise, the seven items assigned to factor 2 are recognised as reflecting the behavioural aspect of integration or the pattern of communication. As such, **factor 1** was labelled Cooperative Task Planning Orientation (CTPO) due to the high loadings (Petter et al., 2007) by the following items in its resultant pattern:

***II2:** Your organisation's functional areas/business units participate in new product and process design with regards to the key business processes*

***II3:** Your organisation's functional areas/business units attend in strategic meetings with regards to the key business processes*

***II6:** All functional teams use common product roadmaps and other procedures to guide product launch*

***II8:** Planning decisions are based on plans agreed upon by all functional teams.*

Similarly, factor 2 was labelled Cooperative Communication (CC) due to the high loadings of its underlying seven items greatly contributing in its conceptualisation:

***III10:** Achieving goals collectively*

***III11:** Having a mutual understanding*

***III12:** Information sharing*

***III13:** Share the same vision for the organisation*

***III14:** Work together as a team*

***III16:** People in different functions/business units are quite accessible to each other*

***III17:** People in different functions/business units coordinate their activities with each other*

The two CTPO and CC constructs are treated as being the formative dimensions of II, suggesting that they exert varying effects on II causing it to emerge. Yet, the inverse is not the case. This conceptualisation is unlikely to suffer from the misspecification of independent formative variables as reflective ones, allowing to prevent biased statistical measurement (Petter et al., 2007). The extant literature draws a distinction between the nature of the two factors. For instance, Ghobadi and D'Ambra (2012) argue that CTPO is manifested in cross-functional members attitudes who get involved in joint responsibilities which is also endorsed by some past researchers (e.g. Blomqvist and Levy, 2006, Ernst and Fischer, 2014). While CC echoes their communication pattern in tasks implementation (Lockstroem et al., 2010, Ghobadi and D'Ambra, 2012, Vallet-Bellmunt and Rivera-Torres, 2013).

### **5.6.Common Method Variance (CMV)**

One of the key issues that must be addressed in a survey research is CMV which is concerned with the use of the same measurement method (i.e. survey) in data collection which may give rise to spurious correlations between the research variables. It could pose a serious threat to a research conclusion, affecting the research merit and the findings validity. Compared to other problematic issues such as non-response bias, response rate, etc, which are common in survey research CMV could account for a larger proportion of variance. It could also become a primary source of systematic error, leading to inflated or deflated relationships between variables (Reio Jr, 2010, Craighead et al., 2011).

In order to test for CMV, this research has taken a series of suggested steps (Podsakoff et al., 2003) prior to data collection such as the use of multiple sources for the selection of items/measures, running a pilot study, ensuring the respondents confidentiality and anonymity, etc. Despite all these procedural remedies, it is argued that CMV could still introduce a potential threat, thus the use of statistical remedies is suggested to further mitigate CMV bias (Reio Jr, 2010). Harman's single-factor test is the most common statistical test utilised for CMV across all fields. This test, developed by Harman (1976) is argued to be the minimum standard for the examination of CMV in OM research (Craighead et al., 2011). In doing Harman's single-factor test CFA is tested to find "the differences between the one-factor model versus the multifactor model [...] via chi-square difference" (Craighead et al., 2011, p.580). Having conducted the test, relatively similar standardised factor loadings were resulted before and after incorporating a common latent factor (CLF). The analysis found that CLF has a regression estimate of 0.69, indicating a variance of 0.47 which is below the 0.50 threshold. Therefore, CMV is not an issue in the present study.

### **5.7.Composite Scores for the Constructs Factors**

Composite scores refer to the process of calculating multiple measures in order to form a reliable and valid measure of the latent construct. Creating composite measures required for the purpose of performing subsequent statistical tests allows to represent a concept drawing on several variables which render different aspects of it (Hair et al., 2014). In order to create composite score the arithmetic mean of variable measuring the same variable was calculated (Fairclough, 2010), utilising summated scales technique (Hair et al., 2014). The use of this technique is justified through several reasons. First, Likert-type scale adopted in the present study makes it the most suitable technique for creating composite scores (Gliem and Gliem). In addition, the process of study replication as well as further statistical investigations are eased. Moreover, it helps minimise the measurement error and multicollinearity (Grapentine, 1997), while also improving scales reliability due to its

emphasise on multiple measures (Hair et al., 2014). Table 5.23 depicts the summated scales with their associated items (retained based on factor analyses) employed in the subsequent regression analyses. Table 5.24 summarises the descriptive statistics of the summated scales, including the sample size, minimum and maximum values, mean estimate, and standard deviation.

Table 5.23. Summated Scales Incorporated in Regression Analyses

Constructs	Factors	Retained Items	Standardised Loadings	Composite Reliability
BPO	PJ	<i>PJ4: The management of our organisation perceives process management not as a single project but as a way of managing the business</i>	0.702	0.829
		<i>PJ5: Management is committed to reviewing and improving the processes in line with the business needs</i>	0.883	
		<i>PJ9: The senior executive team is actively engaged in the key business processes program</i>	0.765	
	PV	<i>PV6: Management tries to eliminate resistance to change by providing a clear vision, and well-defined roles</i>	0.800	0.886
		<i>PV7: Managers convey consistent objectives and a viable vision and strategy to employees with regards to the key business processes</i>	0.927	
		<i>PV8: Managers communicate a defined business process view through training and learning opportunities</i>	0.818	
	PMM	<i>PMM1: Process measurements (e.g. output quality, cycle time, process cost and variability) are defined for the key business processes</i>	0.878	0.917
		<i>PMM2: Specific process performance goals (e.g. target output quality, target cycle time, target process cost and target variability) are in place for the key business processes</i>	0.897	
		<i>PMM3: Process performance (e.g. customer satisfaction, output quality, cycle time) is measured for the key business processes</i>	0.818	
		<i>PMM4: The key business processes outcomes (e.g. real output quality, real cycle time, real process cost and real variability) are measured</i>	0.834	
	PS	<i>PS1: The organisational structure is derived from its key business processes</i>	0.724	0.857
		<i>PS2: The organisation structure supports seamless execution of key business processes across functions</i>	0.803	
		<i>PS3: The firm's organisational structure facilitates integration of flow of activities between functions</i>	0.897	
		<i>PS4: Nearly all activities are executed by cross-functional teams, to which employees are being assigned</i>	0.660	
	CFPVB	<i>CFPVB3: Employees understand that the purpose of their functional area is to fulfil the needs of the internal/external customers</i>	0.757	0.816
		<i>CFPVB4: Individuals on all levels of the organisation are speaking about business processes, customers, teams, process performance indicators, and so on</i>	0.714	
		<i>CFPVB5: Employees know their work affects subsequent works, customers, and the key business processes performance</i>	0.842	

<b>PM</b>		<i>PM2: We can make changes in the key component without redesigning others</i>	0.500	0.754
		<i>PM3: Product components can be reused in various products</i>	0.744	
		<i>PM4: Product has high degree of component carry-over</i>	0.812	
		<i>PM5: Product's components are standardised</i>	0.602	
<b>II</b>	<b>CTPO</b>	<i>II2: Your organisation's functional areas/business units participate in new product and process design with regards to the key business processes</i>	0.763	0.81
		<i>II3: Your organisation's functional areas/business units attend in strategic meetings with regards to the key business processes</i>	0.810	
		<i>II6: All functional teams use common product roadmaps and other procedures to guide product launch</i>	0.687	
		<i>II8: Planning decisions are based on plans agreed upon by all functional teams</i>	0.714	
	<b>CC</b>	<i>III10: Achieving goals collectively</i>	0.840	0.87
		<i>III11: Having a mutual understanding</i>	0.883	
		<i>III12: Information sharing</i>	0.884	
		<i>III13: Share the same vision for the organisation</i>	0.825	
		<i>III14: Work together as a team</i>	0.826	
		<i>III16: People in different functions/business units are quite accessible to each other</i>	0.697	
		<i>III17: People in different functions/business units coordinate their activities with each other</i>	0.714	

Table 5.24. Descriptive Statistics of the Summated Scales for the Three Constructs

Descriptive Statistics						
Constructs	Factors	N	Minimum	Maximum	Mean	Std. Deviation
	<b>PJ</b>	215	2.00	7.00	5.9392	0.94168
	<b>PV</b>	215	2.00	7.00	5.3100	1.11442
	<b>PMM</b>	215	1.75	7.00	5.4186	1.24804
	<b>PS</b>	215	1.75	7.00	5.2523	0.98261
	<b>CFPVB</b>	215	2.00	7.00	5.5705	0.92449
<b>PM</b>		215	1.00	7.00	4.6473	1.35071
<b>II</b>	<b>CTPO</b>	215	2.00	7.00	5.1279	1.05482
	<b>CC</b>	215	2.71	7.00	5.6539	0.88978
<b>Valid N</b>		215				

The quality of the summated scales was confirmed by addressing four issues, including validity, reliability, unidimensionality and conceptual congruence. The first two matters were already examined for the three constructs. Unidimensionality was also evaluated through assessing convergent and discriminate validity. With each item highly loaded on a single factor (for the three latent constructs) and also distinct from other scales, strong statistical evidence is provided confirming the scales unidimensionality (Hair et al., 2014). With regards to the scales conceptual congruence, the researcher ensured to obtain an extensive theoretical understanding in selecting the scales from OM, SCM and BPO literature. This was further warranted through conducting a pilot study which was informed by some academics and field experts knowledge (Hair et al., 2014).

## **5.8. Multiple Regression Analysis (MRA)**

### **5.8.1. Regression Analysis Assumptions for DVs & IVs**

The use of MRA, aiming at modelling a linear regression between the variables, makes it possible to investigate the relationship between several IVs and one DV. It is then considered as an appropriate statistical technique to study the hypothesised relationships between BPO and II. Checking on the MRA assumptions is a priori knowledge one should obtain to ensure that statistical procedures involved in the analysis are not affected by the violation of the assumptions (Hair et al., 2014). Before examining the assumptions, two error terms, i.e. measurement and specification errors, need to be taken into account in the selection of IVs and DVs in order to instil a confidence in effectively conducting MRA. *Measurement error* is the degree of discrepancy between a measure value and its true quantity the effect of which has been diminished by incorporating summated scales. While, *specification error* being the main concern for IVs refers to a wrong choice of IV(s) leading to the exclusion of a true and important variable or the inclusion of an unrelated variable (Hair et al., 2014). Specification error was avoided by addressing the reliability and validity issues of the IVs (Nassar, 2011). Furthermore, following what was suggested by Hair et al. (2014), their inclusion is based on an extensive literature review conducted to provide concrete theoretical support. These variables also went through further verification by academics and industry experts who provided practical support for their inclusion.

#### **5.8.1.1. Regression Analysis Assumptions for Normality**

Each variable is tested separately for evaluating its normality by checking the significant tests of kurtosis and skewness. The tests reported that the values of kurtosis and skewness were mostly within the acceptable range of  $\pm 2.58$  at  $p < 0.01$  (for sample size  $> 200$ ) (Ghasemi and Zahediasl, 2012) except for a few variables. As already discussed for individual items, in large sample sizes ( $> 30$ ) a small deviation from normality assumption should not trigger major issues in analysis, meaning that parametric techniques, here multiple regression, can still be used in this situation and detect significant associations (Ghasemi and Zahediasl, 2012, Tabachnick and Fidell, 2013). Thus, the few variables violated normality assumption do not cause any significant problem. In addition, a series of descriptive statistics were derived for each variable, using SPSS, to make a more reliable judgment on variables normality (Ebrahimi, 2015). Table 5.25 presents the results of descriptive analysis performed for PJ. The table shows the 5% trimmed mean being 6.0315 is not significantly different from the original mean, i.e. 5.9392, with the difference being 0.09. The test was conducted for all the variables and the largest difference was identified to be 0.09, meaning that the extreme values in the dataset do not have any major impact on the mean.

Table 5.25. Descriptive Analysis of PJ

			Statistic	Std. Error
PJ	Mean		5.9392	0.06422
	95% Confidence Interval for Mean	Lower Bound	5.8127	
		Upper Bound	6.0658	
	5% Trimmed Mean		6.0315	
	Median		6.0000	
	Variance		0.887	
	Std. Deviation		0.94168	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		1.33	
	Skewness		-1.424	0.166
	Kurtosis		3.016	0.330

To further check on the variables normality the two most common visual inspection tools (i.e. histogram and normal Q\_Q plots) were employed. The histogram showed a reasonably bell-shaped curve for all the variables. In addition, the normal Q\_Q plot demonstrated that the data points form a roughly straight line for both IVs and DVs, further confirming the variables follow a normal distribution. The above examinations together confirm the normality of the variables.

#### 5.8.1.2. Regression Analysis Assumptions for Residuals

For practical reasons four assumptions are usually addressed for residuals in linear regression, comprising linearity, homoscedasticity (“constant variance of error terms”), “independence of error terms”, and normality of the error terms (Hair et al, 2014: Page 178). Linearity is concerned with the degree of association between the predicted DVs and error terms (Nassar, 2011). In a simpler term, to confirm the linearity assumption the variance of error terms should be constant across the IVs values (Hair et al., 2014). Homoscedasticity is defined as the homogeneity of variance of error terms for all values of IVs (Tabachnick & Fidell, 2007). Linearity and homoscedasticity were assessed through plotting the scatterplots of studentised residual against DVs. This was followed by plotting residuals against predictor variables (Tabachnick & Fidell, 2007). Figure 5.9 & 5.10 demonstrate scatterplot of standardised residual plotted against CTPO and CC (DVs), respectively. The plots revealed that the residuals were dispersed almost equally around the zero line, indicating a random pattern. These plots only depict the combined effect of the IVs, so it would not be possible to control for the effect of each individual variable. Therefore, partial regression plots were used to identify the relationship between each DV and IV independently. The same results were obtained, indicating that no violation of homoscedasticity and linearity was detected.



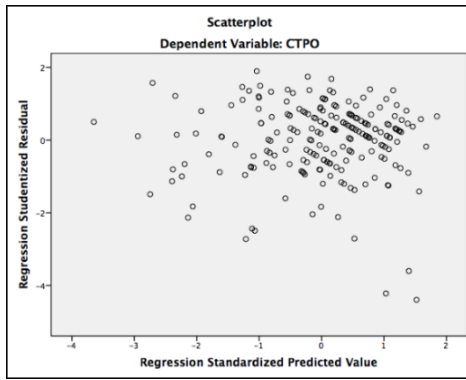


Figure 5.9. Scatterplot of Standardised Residual Against CTPO

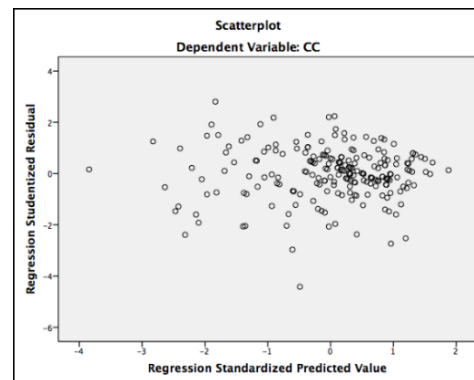


Figure 5.10. Scatterplot of Standardised Residual Against CC

The third assumption, independence of the error terms is examined through plotting standardised residuals “against any possible sequencing variable” (Hair et al., 2014: p.181), which allows a visual inspection. It refers to the independency of the IVs predicted values from other observations. The plot depicted a random pattern of the residuals which was relatively similar to a null plot. Durbin-Watson test was also employed to detect the presence of autocorrelation among the errors terms (Tabachnick and Fidell, 2013). The test resulted in acceptable values of 1.933 and 2.168 for CTPO and CC, respectively, with the acceptable range being between 1.5 and 2.5 (Ahsan et al., 2009, Shah Alam and Mohamed Sayuti, 2011). Therefore, the assumption of independence of the error terms is satisfied. And finally, the examination of normality of the error terms was performed through visual inspection of histogram and normal probability plot (P-P). Figure 5.11 which depicts normality of residual for CTPO, represents that residuals are normally distributed, closely following the diagonal in Figure 5.12 with no major deviation from the line. The same graphs were produced for CC, confirming the normality of error terms assumption for this variable. The graphs are presented in Figure 5.13 & 5.14.

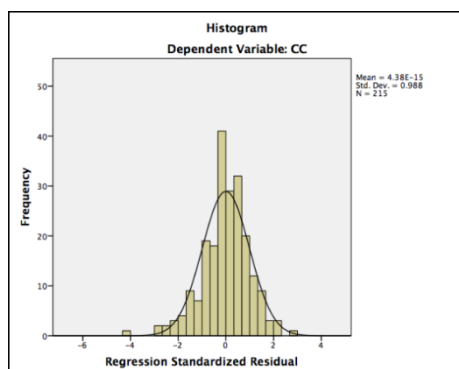


Figure 5.11. Histogram of Residual for CTPO

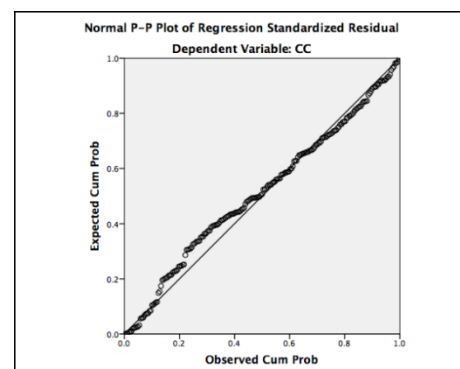


Figure 5.12. Normal P-P Plot of Residual for CTPO

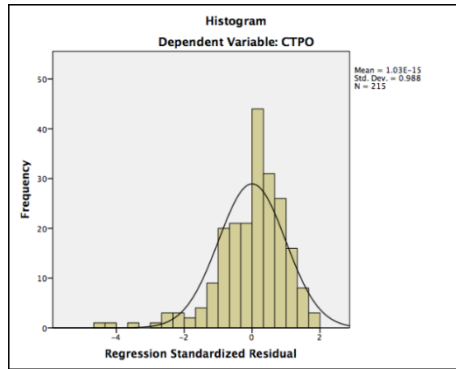


Figure 5.13. Histogram of Residual for CC

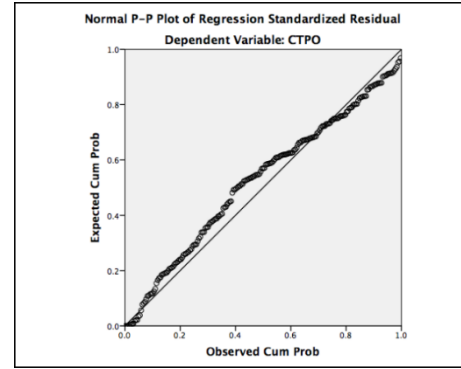


Figure 5.14. Normal P-P Plot of Residual for CC

### 5.8.1.3. Multicollinearity Between IVs

The absence of multicollinearity between the IVs needs to be ensured prior to conducting MRA as it could be serious compromise to the estimate power of regression tests and their statistical significance (Tabachnick and Fidell, 2013). Multicollinearity was assessed using bivariate correlation matrix as well as examining VIF indicator. No high correlation ( $> 0.9$ ) was found among the IVs. The VIF values were also found to be below the target value of 10 (Hair et al, 2014, Byrne, 2013), suggesting that the regression analysis results will not be affected by multicollinearity issue.

### 5.8.2. Bivariate Correlation Matrix

This section draws on the strength and significance of the correlations between variables. MRA is initiated by first conducting a bivariate correlation in order to determine the strength of the relationship between the main research variables (Hair et al., 2014). The strength of the relationship may vary depending on the value of correlation coefficient, where 0.1 represents a low correlation, and 0.3 and 0.5 denote medium and high correlations, respectively. Table 5.26 contains the correlation coefficient estimates between the IVs (PJ, PV, PMM, PS, CFPVB, PM), DVs (CTPO and CC) as well as the control variable (i.e. firm size). Firm size is assessed based on two measures of ‘Annual Sales’ and ‘No of Employees’. As for Industry type comprising 5 distinct sectors, it was already discussed that this research does not aim to perform independent analysis on each sector. To further ensure about this assumption empirically, a series of t-tests were conducted, and no significance difference was found between the means of the five sectors. Thus, they will be treated as being part of the same homogenous population.

Table 5.26. Correlation Matrix (IVs & DVs)

Variables	N	Mean	Std. Deviation	PJ	PV	PMM	PS	CFPVB	PM	CC	CTPO	Firm Size (Annual Sales)	Firm Size (Number of Employees)
<b>PJ</b>	215	5.9392	0.94168	1									
<b>PV</b>	215	5.3100	1.11442	0.657**	1								
<b>PMM</b>	215	5.4186	1.24804	0.471**	0.587**	1							
<b>PS</b>	215	5.2523	0.98261	0.622**	0.640**	0.515**	1						
<b>CFPVB</b>	215	5.5705	0.92449	0.470**	0.516**	0.481**	0.604**	1					
<b>PM</b>	215	4.6473	1.35071	0.031	0.013	-0.114	-0.021	0.017	1				
<b>CC</b>	215	5.6539	0.88978	0.556**	0.602**	0.499**	0.672**	0.648**	0.024	1			
<b>CTPO</b>	215	5.1279	1.05482	0.508**	0.623**	0.554**	0.596**	0.539**	0.006	0.623**	1		
<b>Firm Size (Annual sales)</b>	208	£410,899,274.10	£4,406,022,203.097	-0.043	-0.025	0.017	0.017	0.012	0.017	-0.006	0.079	1	
<b>Firm Size (Number of Employees)</b>	212	566.81	3496.284	-0.028	-0.056	0.057	-0.150*	-0.141*	-0.004	-0.139*	-0.014	0.110	1
** Correlation is significant at the 0.01 level (2-tailed)													
* Correlation is significant at the 0.05 level (2-tailed)													

In general, the results reported in Table 5.26 showed moderate to high correlations between the variables. The positive correlations confirm the existence of positive relationships between the BPO dimensions (IVs) and II factors (DVs), providing initial support to the hypotheses. The results suggested that there was no significant correlation between PM and II, with the coefficient values being very close to zero. This result was expected as PM was theoretically hypothesised as a moderator. Correlations between the main variables are mostly significant at 0.01 level, with some correlations being significant at 0.05 level as well between the control variables.

In considering the correlation matrix, each predictor variable is examined individually to scrutinise its initial relationship with the criterion variables. PJ demonstrated high positive correlations with other dimensions of BPO, i.e. PV, PMM, PS, and CFPVB, ( $r$  being 0.657, 0.471, 0.622, and 0.470, respectively). The high correlation between PJ and II dimensions, i.e. CC and CTPO, is also confirmed with the correlation coefficients being 0.556 and 0.508, respectively. However, looking at the moderator variable (PM) and the control variables no significant correlation was found with PJ. Similarly, PV showed high and positive correlations with PJ, PMM, PS, and CFPVB as well as the two criterion variables (CC and CTPO), ( $r$  being 0.657, 0.587, 0.640, 0.516, 0.556, and 0.508, respectively). While, no significant correlation was reported between PV, PM and control variables. With regards to PMM, high correlations were detected in relation to PJ, PV, PS, CFPVB, CTPO and CC, ranging from 0.471 to 0.587. Yet, no significant correlation was detected between PMM, PM and the control variables. Similar results were produced for the two supporting elements (i.e. PS and CFPVB). They both illustrated high and positive correlations with each other as well as the three basic elements. PS was highly correlated with CC and CTPO ( $r$  being 0.672 and 0.596, respectively), while CFPVB correlations were slightly lower ( $r=0.648$  and 0.539 for CC and CTPO, respectively). No significant correlation was identified between the two supporting elements and PM. Additionally, both variables are correlated significantly with 'Number of Employees'.

### 5.8.3. Hypothesis Testing: Multiple Regression Analysis

With all the regression analysis assumptions assessed and confirmed through a series of tests discussed earlier, this section proceeds to model-building process. Having specified the set of IVs in the Parallel Model, this research employed standard multiple regression in which the five IVs are entered into the model at the same time, while controlling for the control variables. This research is informed by an extensive theoretical foundation in employing this technique, aiming to employ a confirmatory approach in the model specification (Hair et al., 2014). Moreover, no predetermined order is assumed in the Parallel Model for the five IVs which makes this analytic strategy a suitable technique for testing this model (Tabachnick and Fidell, 2013). As for the Mediation and Hierarchical Models, the hierarchical/sequential regression is adopted, based on the theoretical understanding obtained from the supporting elements of BPO and the Key Turning Points (KTPs) in BPO maturity model.

The analyses are initiated by examining the five hypotheses in the Parallel Model performed in two separate regression models. First, CTPO is regressed against the five BPO indicators, and the results are examined and interpreted. Then a separate multiple regression is conducted for CC regressed against the five IVs. This will be followed by analysing the other two competing models, i.e. the Mediation and Hierarchical Models. Taking Chamberlin (1890/1965)'s approach, a comparison analysis is also performed in order to identify the most well-established model in explaining II. Chamberlin's approach allows for the comparison of the models "against one another, rather than against an arbitrary standard" (Krueger Jr et al., 2000, p.420). Finally, the moderation effect of PM will be explored on the competing model identified from the multivariate analyses.

#### 5.8.3.1. The Parallel Model Regression Analysis: Testing the Direct Relationship Between BPO Dimensions and CTPO

The main effect of the five BPO dimensions shown in Figure 5.15 were assessed testing hypotheses 1.a-1.e:

**Hypothesis 1.a (H1.a +):** *"The degree of process job (PJ) has a positive impact on the degree of internal integration (II)."*

**Hypothesis 1.b (H1.b +):** *"The degree of process view (PV) has a positive impact on the degree of internal integration (II)."*

**Hypothesis 1.c (H1.c +):** *"The degree of process management & measurement (PMM) has a positive impact on the degree of internal integration (II)."*

**Hypothesis 1.d (H1.d +):** *"The degree of process structure (PS) has a positive impact on the degree of internal integration (II)."*

**Hypothesis 1.e (H1.e +):** “The degree of customer-focused process values and beliefs (CFPVB) has a positive impact on the degree of internal integration (II).”

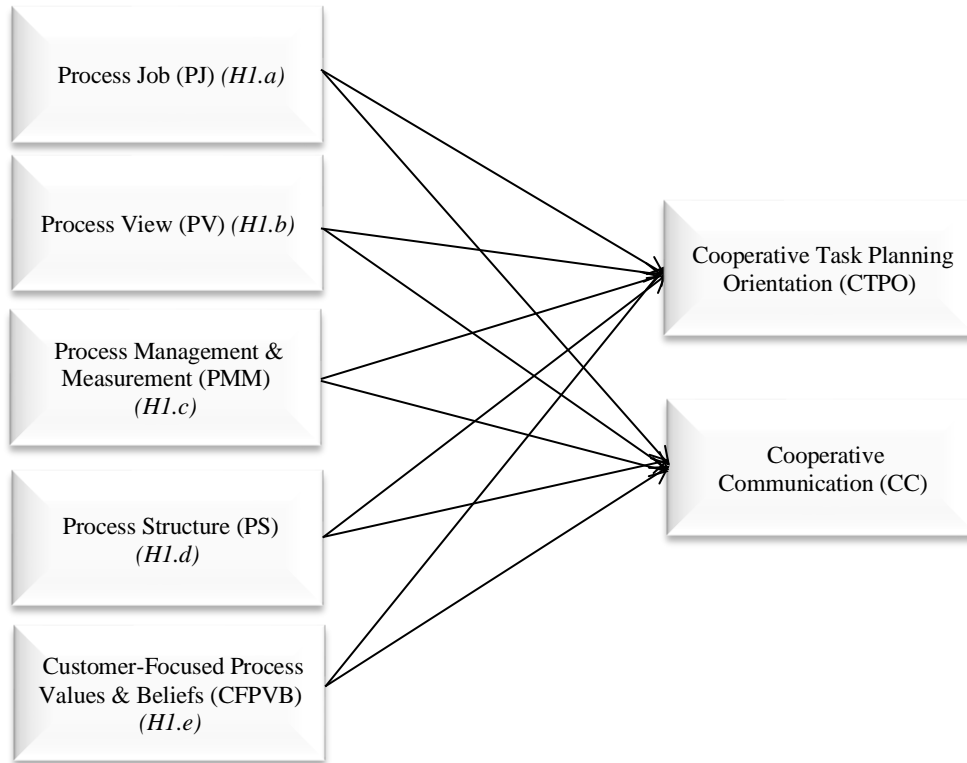


Figure 5.15. The Parallel Model

Table 5.27 presents the results of regression analyses conducted to estimate the relationship between the five IVs and CTPO, using SPSS. CTPO was regressed against the five BPO dimensions and the control variables (i.e. Annual Sales, No of Employees). The two control variables were first entered into the model to control for their effect. The multiple regression with all the predictors produced  $R^2=0.525$ ,  $F(13, 192)=16.318$  (Table 5.28),  $p<0.05$  ( $p=0.000$ ). This indicates that 52.5% of the variance in CTPO was explained by the five IVs, i.e. PJ, PV, PMM, PS, CFPVB, and two control variables. To avoid overestimating the prediction effect of the variables, *Adjusted R<sup>2</sup>* which provides a better prediction result is used (Tabachnick and Fidell, 2013). *Adjusted R<sup>2</sup>* representing a relatively smaller estimate value was 0.493, meaning that 49.3% of the variance in CTPO is explained by the five IVs and the control variables. The resultant difference between  $R^2$  and *Adjusted R<sup>2</sup>*, i.e. 3.2%, is negligible, confirming the cross-validity of the regression model (Field, 2000). Analysing the Change Statistics results,  $R^2$  Change was identified to be significant at  $p<0.05$  ( $p=0.000$ ). Significance of the results is determined by examining ANOVA outputs reported in Table

5.28. The significant result of ANOVA proved the predictability of the CTPO through the five IVs.

Table 5.27. Multiple Regression Results for CTPO

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate	Change Statistics				
					R <sup>2</sup> Change	F Change	df1	df2	Sig. F Change
1	0.174 <sup>a</sup>	0.030	-0.004	1.06079	0.030	0.878	7	198	0.525
2	0.725 <sup>b</sup>	0.525	0.493	0.75393	0.495	33.323	6	192	0.000

a. Predictors: (Constant), Annual Sales, No of Employees  
b. Predictors: (Constant), Annual Sales, No of Employees, PV, PMM, CFPVB, PS, PJ  
\*P<0.05

Table 5.28. Significance of the Regression Model Results (ANOVA Output)

Model		SS	df	Mean Square	F	Sig.
1	Regression	6.915	7	0.988	0.878	0.525 <sup>b</sup>
	Residual	222.803	198	1.125		
	Total	229.718	205			
2	Regression	120.583	13	9.276	16.318	0.000 <sup>c</sup>
	Residual	109.135	192	0.568		
	Total	229.718	205			

\*P<0.05

Each individual variable was also evaluated to identify its unique contribution to the model. To do this *Standardised Beta Coefficient* value for each variable was assessed. The results are presented in Table 5.29. The examination of the *Beta Coefficients* showed that only PV, PMM, PS, and CFPVB make statistically significant contribution in predicting CTPO, partially supporting *hypotheses 1.b-1.e*. However, drawing on the value of PJ *Beta Coefficient*, *hypotheses 1.a* is not supported. Moreover, the two control variables were found to make no significant contribution.

Table 5.29. The Unique Contribution of Each Predictor Variable in Prediction of CTPO (Beta Coefficients)

Model		Unstandardized Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.709	0.433		10.873	0.000
	Annual Sales	-7.912E-006	0.000	-0.027	-0.359	0.720
	No of Employees	2.183E-011	0.000	0.091	1.285	0.200
2	(Constant)	4.502	0.310		14.510	0.000
	Annual Sales	1.795E-005	0.000	0.060	1.113	0.267
	No of Employees	1.792E-011	0.000	0.075	1.475	0.142
	PJ	0.059	0.080	0.053	0.739	0.461
	PV	0.255	0.073	0.271	3.479	0.001
	PMM	0.162	0.057	0.190	2.834	0.005
	PS	0.199	0.082	0.185	2.436	0.016
	CFPVB	0.216	0.077	0.188	2.806	0.006

### 5.8.3.2. The Parallel Model Regression Analysis: Testing the Direct Relationship Between BPO Dimensions and CC

A separate regression was conducted to predict CC through BPO factors. This was investigated using the five *hypotheses (H1a-1e)* specified in Figure 5.15. The control variables were first regressed against CC to control for their effect, followed by entering the five BPO variables into the model. The results are presented in Table 5.30 in which CC was found to be positively influenced by the five predictors producing  $Adjusted R^2=0.594$ ,  $F(13, 192) = 24.070$ ,  $p<0.05$  (Table 5.31). This suggests that overall 59.4% of the variance in CC is explained by PJ, PV, PMM, PS, CFPVB after controlling for the effect of firm size. The results, however, revealed no significant contribution to the regression model by the control variables. The overall effect of the five BPO factors on CC was slightly higher than that of on CTPO discussed earlier ( $CTPO Adjusted R^2=0.493 < CC Adjusted R^2=0.594$ ). Drawing on the ANOVA test outputs (Table 5.31) this research confirms the predictive power of the five IVs in explaining 59.4% of variance in CC. Therefore, the inclusion of the five IVs made a huge difference in predictability of the model, suggesting a statistically significant change in CC variability ( $p<0.05 F=24.070$ ).

Table 5.30. Multiple Regression Results for CC

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate	Change Statistics				
					R <sup>2</sup> Change	F Change	df1	df2	Sig. F Change
1	0.235 <sup>a</sup>	0.055	0.022	0.88792	0.055	1.655	7	198	0.122
2	0.787 <sup>b</sup>	0.620	0.594	0.57207	0.564	47.500	6	192	0.000
a. Predictors: (Constant), Annual Sales, No of Employees									
b. Predictors: (Constant), Annual Sales, No of Employees, PV, PMM, CFPVB, PS, PJ									
* $P<0.05$									

Table 5.31. Significance of the Regression Model Results (ANOVA Output)

Model		SS	df	Mean Square	F	Sig.
1	Regression	9.132	7	1.305	1.655	0.122 <sup>b</sup>
	Residual	156.105	198	0.788		
	Total	165.237	205			
2	Regression	102.403	13	7.877	24.070	0.000 <sup>c</sup>
	Residual	62.834	192	0.327		
	Total	165.237	205			
* <i>P</i> <0.05						

In order to identify the unique contribution of each variable to the model prediction, all IVs were individually assessed in terms of their corresponding *Standardised Beta Coefficient* shown in Table 5.32. The examination of the *Beta Coefficients* showed that only PS, and CFPVB make statistically significant contribution ( $p<0.05$ ) in predicting CC, suggesting that CC is mainly influenced by the two supporting elements of BPO. Therefore, taking together the results of CTPO and CC *hypotheses 1.d and 1.e* are fully supported. In line with the result obtained for CTPO, lack of significant effect between the PJ-CC relationship



provided no support for *hypothesis 1.a*. Additionally, PV and PMM were found to have no significant effect on CC, suggesting that *hypotheses 1.b and 1.c* are partially supported. The PV-CC relationship, however, will prove to be incorrect after conducting post-hoc analysis presented in the following section. The two control variables were also found to make no significant contribution to CC variability.

Table 5.32. The Unique Contribution of Each Predictor Variable in Prediction of CC (Beta Coefficients)

Model		Unstandardized Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.790	0.363		15.972	0.000
	Annual Sales	-3.394E-005	0.000	-0.134	-1.838	0.068
	No of Employees	4.235E-012	0.000	0.020	0.292	0.770
2	(Constant)	5.580	0.235		23.700	0.000
	Annual Sales	-5.060E-006	0.000	-0.020	-0.414	0.680
	No of Employees	-5.993E-013	0.000	-0.002	-0.054	0.957
	PJ	0.112	0.061	0.118	1.829	0.069
	PV	0.105	0.056	0.131	1.890	0.060
	PMM	0.058	0.043	0.080	1.332	0.185
	PS	0.271	0.062	0.296	4.363	0.000
	CFPVB	0.306	0.058	0.314	5.242	0.000

### 5.8.3.3. Post-Hoc Analysis Verifying the Parallel Model Regression Results

A stepwise regression technique was utilised to compare the results with the confirmatory approach. The results showed a poorer overall model fit for CTPO. The regression resulted in four distinct models, retaining the same four IVs found to have significant regression weights previously. *Adjusted R<sup>2</sup>* relatively decreased from 0.493 to 0.386 (with PV considered for inclusion in model 1 as making the largest contribution to the CTPO prediction). Likewise, model 2, model 3 and model 4 showed a decrease in *Adjusted R<sup>2</sup>*, indicating poorer model fits (0.493 to 0.448 in model 2, 0.493 to 0.472 in model 3, and 0.493 to 0.489 in model 4). Hence, the overall contribution of the four IVs (PV, PS, PMM, and CFPVB) included in model 4 (i.e. 48.9% of the variance) indicated that stepwise regression analysis generated fairly similar results to that of standard multiple regression, further confirming the amount of variance explained by the four IVs in CTPO.

Stepwise regression analysis was also run for CC. *Adjusted R<sup>2</sup>* decreased from 0.594 to 0.472 (with PS considered for inclusion in model 1 as making the largest contribution to prediction of CC). With *Adjusted R<sup>2</sup>* of, respectively, 0.572 in model 2, 0.593 in model 3 and 0.599 in model 4, three IVs, i.e. PS, CFPVB, and PV, showed to make statistically significant contribution to the model. While it could be argued that the rise in SEE (Standard Error of

Estimate) suggests that Adjusted  $R^2$  may not be a good indicator determining the predictive accuracy of the additional IV (PV), since it could be affected by the relatively high correlations between PV and PS, i.e. 0.640, this is not a sign of multicollinearity as all VIFs were below the target value of 10 (Hair et al., 2014). On that account and drawing upon the results from post hoc analyses, it is confirmed that further increase in  $R^2$  is obtained as a result of PV addition, thus PV accounts for part of the variance in CC, as well. Therefore, *hypothesis 1.b* is fully supported. This will be further confirmed in the section where the moderation effect of PM on the Parallel Model is examined.

#### 5.8.4. The Mediation Model Regression Analysis: Draw from the Supporting Elements of PS and CFPVB

The Mediation Model shown in Figure 5.16 was examined testing *hypotheses 2.a-2.f*:

**Hypothesis 2.a (H2.a +):** “PJ mediates the positive effect of PS on II.”

**Hypothesis 2.b (H2.b +):** “PV mediates the positive effect of PS on II.”

**Hypothesis 2.c (H2.c +):** “PMM mediates the positive effect of PS on II.”

**Hypothesis 2.d (H2.d +):** “PJ mediates the positive effect of CFPVB on II.”

**Hypothesis 2.e (H2.e +):** “PV mediates the positive effect of CFPVB on II.”

**Hypothesis 2.f (H2.f +):** “PMM mediates the positive effect of CFPVB on II.”

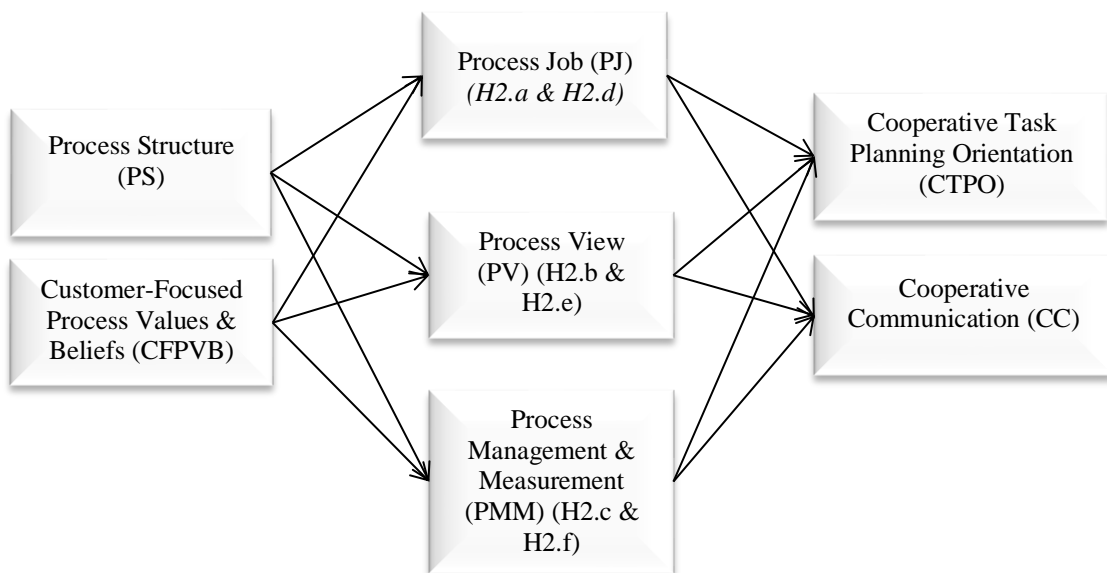


Figure 5.16. The Mediation Model

To test the Mediation Model this research conducted simple and multiple mediation regression analyses using PROCESS macro on SPSS. Multiple simple mediation analyses were run (with one IV, one mediator and one DV at a time) to investigate the specific mediation effect between the supporting and basic elements of BPO and II factors. A simple

mediation allowed the researcher to analyse one mediator at a time, while also isolating the potential interaction effects which may be present among the three mediators. At the same time, multiple mediation analysis (MMA) was performed to account for the interaction effects through including all the mediators in one model. This allows to detect any changes occurring in the effect of one mediator in the presence of others (MacKinnon et al., 2012). Bootstrapping technique was also used to evaluate the mediation effects in the hypothetical population. This involved estimating the quantities in the sample population through taking the average of the values calculated using several random samplings (i.e. 1000) from the 215 observations (MacKinnon et al., 2012). To identify the direct and indirect effect of PS and CFPVB on the two DVs, i.e. CTPO and CC, this research first regressed PJ, PV and PMM against the two supporting elements. This was, then, followed by regressing the DVs against PS and CFPVB as well as the three basic elements. The results are presented in Table 5.33.

Table 5.33. The Simple Mediation Model Outputs from PROCESS macro on SPSS

IVs	DVs						Indirect Effect with mediator	Direct Effect without mediator	Remark
	Coeff.	SE	p	Coeff.	SE	p			
PS	0.5957	0.0514	0.0000	0.4911	0.0738	0.0000	0.1489	0.4911	Complementary mediation
PJ	-	-	-	0.2500	0.0770	0.0014		P=0.0000	
	R-Square=0.3864 P=0.0000			R-Square=0.3860 P=0.0000			LLCI=0.0491 ULCI=0.2662	LLCI=0.3458 ULCI=0.6365	
	M(PJ)			Y(CC)					
PS	0.5957	0.0514	0.0000	0.4821	0.0571	0.0000	0.1267	0.4821	Complementary mediation
PJ	-	-	-	0.2127	0.0596	0.0004		P=0.0000	
	R-Square=0.3864 P=0.0000			R-Square=0.4832 P=0.0000			LLCI=0.0479 ULCI=0.2341	LLCI=0.3696 ULCI=0.5946	
	M(PJ)			Y(CTPO)					
CFPVB	0.4786	0.0616	0.0000	0.4394	0.0703	0.0000	0.1751	0.4394	Complementary mediation
PJ	-	-	-	0.3658	0.0690	0.0000		P=0.0000	
	R-Square=0.2208 P=0.0000			R-Square=0.3732 P=0.0000			LLCI=0.0824 ULCI=0.2693	LLCI=0.3009 ULCI=0.5779	
	M(PJ)			Y(CC)					
CFPVB	0.4786	0.0616	0.0000	0.4776	0.0529	0.0000	0.1461	0.4776	Complementary mediation
PJ	-	-	-	0.3051	0.0519	0.0000		P=0.0000	
	R-Square=0.2208 P=0.0000			R-Square=0.5011 P=0.0000			LLCI=0.0827 ULCI=0.2218	LLCI=0.3733 ULCI=0.5818	
	M(PV)			Y(CTPO)					
PS	0.7254	0.0597	0.0000	0.3589	0.0708	0.0000	0.2812	0.3589	Complementary mediation
PV	-	-	-	0.3876	0.0625	0.0000		P=0.0000	
	R-Square=0.4091 P=0.0000			R-Square=0.4546 P=0.0000			LLCI=0.1772 ULCI=0.4031	LLCI=0.2193 ULCI=0.4985	
	M(PV)			Y(CC)					
PS	0.7254	0.0597	0.0000	0.4405	0.0571	0.0000	0.1683	0.4405	Complementary mediation
PV	-	-	-	0.2320	0.0503	0.0000		P=0.0000	
	R-Square=0.4091 P=0.0000			R-Square=0.5020 P=0.0000			LLCI=0.0903 ULCI=0.2632	LLCI=0.3280 ULCI=0.5531	
	M(PV)			Y(CTPO)					
CFPVB	0.6215	0.0708	0.0000	0.3375	0.0677	0.0000	0.2770	0.3375	Complementary mediation
PV	-	-	-	0.4456	0.0561	0.0000		P=0.0000	
	R-Square=0.2658 P=0.0000			R-Square=0.4528 P=0.0000			LLCI=0.1742 ULCI=0.3934	LLCI=0.2042 ULCI=0.4709	
	M(PV)			Y(CC)					
CFPVB	0.6215	0.0708	0.0000	0.4427	0.0536	0.0000	0.1809	0.4427	Complementary mediation
PV	-	-	-	0.2911	0.0445	0.0000		P=0.0000	
	R-Square=0.2658 P=0.0000			R-Square=0.5174 P=0.0000			LLCI=0.1084 ULCI=0.2767	LLCI=0.3370 ULCI=0.5483	
	M(PMM)			Y(CTPO)					
PS	0.6539	0.0746	0.0000	0.4540	0.0644	0.0000	0.1860	0.4540	Complementary mediation
PMM	-	-	-	0.2845	0.0507	0.0000		P=0.0000	
	R-Square=0.2650 P=0.0000			R-Square=0.4388 P=0.0000			LLCI=0.0996 ULCI=0.2894	LLCI=0.3270 ULCI=0.5810	
	M(PMM)			Y(CC)					
PS	0.6539	0.0746	0.0000	0.5121	0.0521	0.0000	0.0967	0.5121	Complementary mediation
PMM	-	-	-	0.1479	0.0410	0.0004		P=0.0000	

	<i>R-Square=0.2650</i> <i>P=0.0000</i>			<i>R-Square=0.4837</i> <i>P=0.0000</i>			<i>LLCI=0.0278</i> <i>ULCI=0.1759</i>	<i>LLCI=0.4094</i> <i>ULCI=0.6149</i>	
	<i>M (PMM)</i>			<i>Y (CTPO)</i>					
CFPVB	0.6496	0.0811	0.0000	0.4036	0.0690	0.0000	0.2109	0.4036 <i>P=0.0000</i>	Complementary mediation
PMM	-	-	-	0.3247	0.0511	0.0000			
	<i>R-Square=0.2316</i> <i>P=0.0000</i>			<i>R-Square=0.4035</i> <i>P=0.0000</i>			<i>LLCI=0.0521</i> <i>ULCI=0.1145</i>	<i>LLCI=0.2675</i> <i>ULCI=0.5397</i>	
	<i>M (PMM)</i>			<i>Y (CC)</i>					
CFPVB	0.6496	0.0811	0.0000	0.5110	0.0551	0.0000	0.1126	0.5110 <i>P=0.0000</i>	Complementary mediation
PMM	-	-	-	0.1733	0.0408	0.0000			
	<i>R-Square=0.2316</i> <i>P=0.0000</i>			<i>R-Square=0.4652</i> <i>P=0.0000</i>			<i>LLCI=0.0491</i> <i>ULCI=0.1864</i>	<i>LLCI=0.4023</i> <i>ULCI=0.6197</i>	

The results showed that all the indirect effects are statistically different from zero as all the 95% bootstrap (5000 bootstrapping) confidence intervals were above zero (Hayes, 2013). For example, the total indirect effect of PS through PJ is 0.1489 with the confidence interval falling between *LLCI=0.0491* and *ULCI=0.2662* reported in Table 5.33. Furthermore, all the direct effects without mediators are also statistically significant with *p=0.0000*. However, all the path coefficients have dropped when the three basic elements of BPO introduced as mediators between supporting elements and DVs. This is an indication of complementary mediation, meaning that only part of the total effect of PS and CFPVB on CTPO and CC is transmitted by the three basic elements (Diamantopoulos and Winklhofer, 2001, Xanthopoulou et al., 2007, Flynn et al., 2010). Therefore, the simple mediation models are fully supported, suggesting the presence of complementary mediation effect where both direct and indirect effects exist at the same direction (Flynn et al., 2010).

To identify which mediation model better fits the data, this research also examined a multiple mediation model where a combination of the three basic elements was introduced all at once as mediators between the two supporting elements and DVs. The results reported in Table 5.34 revealed interesting outcomes. As a result of introducing the three mediators into the model the effect of other mediators changed on the outcome variables, suggesting the possibility of some interaction effects between the variables (Preacher and Hayes, 2008). Previously, it was found that the specific indirect effects of PS and CFPVB on CTPO and CC through the three basic elements were statistically significant and different from zero. The inclusion of the three mediators at the same time, however, showed that the significant indirect effect of PS on CTPO through PJ, as illustrated in Block 1, became insignificant. Thus, PJ was not a significant mediator of the effect of PS on CTPO, while controlling for the effect of PV and PMM. This further affected the indirect effect of PS on CC, resulting in only one significant mediation effect through PV (0.1089, *LLCI= 0.0187* and *ULCI=0.2073*). The same results were uncovered for CFPVB where the significant effect of CFPVB on CTPO through PJ became insignificant in the presence of the three mediators in the model, Block 3. Moreover, the inclusion of the three basic elements yielded only one mediating pathway from CFPVB on CC through PV (0.1115, *LLCI= 0.0395* and *ULCI=0.2072*). Therefore, this suggests that, based on the results obtained from the multiple mediation model, only PV and

PMM contributes to the indirect effect of PS and CFPVB on CTPO, while PJ showed no mediating effect. This result was expected since, under the Parallel Model, no direct effect was found for PJ on DVs. In addition, only PV was identified to contribute to the indirect effect of PS and CFPVB on CC.

Table 5.34. The Multiple Mediation Model Outputs from PROCESS Macro on SPSS

Block	IVs	DVs								Indirect effects	Total Effect (c)	Direct effect (c')
		Coeff.	p	Coeff.	p	Coeff.	p	Coeff.	p			
		M (PJ)		M (PV)		M (PMM)		Y (CTPO)				
1	PS	0.5957	0.0000	0.7254	0.0000	0.6539	0.0000	0.2859	0.0002		0.6400 P=0.0000	0.2859 P=0.0002
	PJ	-	-	-	-	-	-	0.0494	0.5297	0.0294 LLCI=-0.0603 ULCI=0.1305		
	PV	-	-	-	-	-	-	0.2762	0.0002	0.2003 LLCI=0.1019 ULCI=0.3039		
	PMM	-	-	-	-	-	-	0.1902	0.0004	0.1244 LLCI=0.0493 ULCI=0.2162		
		R-Square=0.3864 P=0.0000		R-Square=0.4091 P=0.0000		R-Square=0.2650 P=0.0000		R-Square=0.4878 P=0.0000		-		
2	PS	0.5957	0.0000	0.7254	0.0000	0.6539	0.0058	0.3795	0.0000		0.6088 P=0.0000	0.3795 P=0.0000
	PJ	-	-	-	-	-	-	0.1101	0.0877	0.0656 LLCI=-0.0262 ULCI=0.1549		
	PV	-	-	-	-	-	-	0.1502	0.0110	0.1089 LLCI=0.0187 ULCI=0.2073		
	PMM	-	-	-	-	-	-	0.0837	0.0550	0.0547 LLCI=-0.0251 ULCI=0.1384		
		R-Square=0.3864 P=0.0000		R-Square=0.4091 P=0.0000		R-Square=0.2650 P=0.0000		R-Square=0.5184 P=0.0000		-		
3	CFPVB	0.4786	0.0000	0.6215	0.0000	0.6496	0.0000	0.2605	0.0002		0.6145 P=0.0000	0.2605 P=0.0002
	PJ	-	-	-	-	-	-	0.0980	0.1949	0.0469 LLCI=-0.0277 ULCI=0.1212		
	PV	-	-	-	-	-	-	0.3053	0.0000	0.1897 LLCI=0.0987 ULCI=0.2853		
	PMM	-	-	-	-	-	-	0.1870	0.0009	0.1174 LLCI=0.0433 ULCI=0.2090		
		R-Square=0.2208 P=0.0000		R-Square=0.2658 P=0.0000		R-Square=0.2316 P=0.0000		R-Square=0.4869 P=0.0000		-		
4	CFPVB	0.4786	0.0000	0.6215	0.0000	0.6496	0.0000	0.3920	0.0000		0.6236 P=0.0000	0.3920 P=0.0000
	PJ	-	-	-	-	-	-	0.1659	0.0063	0.0794 LLCI=-0.0083 ULCI=0.1518		
	PV	-	-	-	-	-	-	0.1795	0.0015	0.1115 LLCI=0.0395 ULCI=0.2072		
	PMM	-	-	-	-	-	-	0.0626	0.1450	0.0407 LLCI=-0.0309 ULCI=0.1153		
		R-Square=0.2208 P=0.0000		R-Square=0.2658 P=0.0000		R-Square=0.2316 P=0.0000		R-Square=0.5404 P=0.0000		-		

Table 5.35 was reported to illustrate the results of the magnitude indirect effects through the three basic elements. However, since all the intervals, i.e. LLCI and ULCI, contain zero the magnitude of the indirect effect for the three mediators cannot be distinguished. This is argued to occur when the value of one of the involved indirect effects is very close to zero (Danaher et al., 2008, Preacher and Hayes, 2008).

Table 5.35. The Pairwise Contrast of the Three Mediators

Block	Contrasts	Effects	LLCI	ULCI
1	C1 (PJ vs PV)	-0.1709	-0.3231	0.0126
	C2 (PJ vs PMM)	-0.0950	-0.2381	0.0411
	C3 (PV vs PMM)	0.0760	-0.0640	0.2073
2	C1 (PJ vs PV)	-0.0433	-0.1858	0.0947
	C2 (PJ vs PMM)	0.0109	-0.1303	0.1534
	C3 (PV vs PMM)	0.0542	-0.0916	0.2001
3	C1 (PJ vs PV)	-0.1428	-0.2789	0.0090
	C2 (PJ vs PMM)	0.0705	-0.2040	0.0430
	C3 (PV vs PMM)	0.0723	-0.0564	0.2006
4	C1 (PJ vs PV)	-0.0321	-0.1600	0.0726
	C2 (PJ vs PMM)	0.0387	-0.0812	0.1603
	C3 (PV vs PMM)	0.0708	-0.0442	0.2065

Overall, the results obtained from simple mediation tests indicated that PJ, PV, and PMM act as simple mediators, while in multiple mediation analyses only PV and PMM emerged as mediators, with PJ falling out as a mediator. These results accentuated the complexity of the interplay between the three variables. Therefore, it is concluded that PV and PMM have a complimentary mediation effect (Flynn et al., 2010) on the relationship between the supporting elements and CTPO. For example, once PMM is added to the model (controlling for PV and PJ), the direct effect of PS on CTPO is reduced in magnitude from 0.3589 (in simple mediation) to 0.2859 (in multiple mediation) at  $p < 0.05$ . The same result is detected once PV and PMM are included in as the mediators between CFPVB and CTPO, indicating that the direct effect of CFPVB on CTPC is reduced in magnitude from 0.3375 to 0.2605 at  $p < 0.05$ . Nevertheless, when it comes to the relationship between the supporting elements and CC, only PV was identified to act as a complementary mediator of the relationship. In sum, the resulted provided evidence fully supporting *hypotheses 2.b and 2.e*, while partially supporting *hypotheses 2.c and 2.f*. However, *hypotheses 2.a and 2.d* were not supported.

### 5.8.5. The Hierarchical Model Regression Analysis

The Hierarchical Model shown in Figure 5.17 was assessed testing *hypotheses 3.a and 3.b*:

**Hypothesis 3.a (H3.a +):** “PMM has a positive effect on the level of II, given that PJ is already developed.”

**Hypothesis 3.b (H3.b +):** “PV has a positive effect on the level of II, given that PJ and PMM are already developed, respectively.”

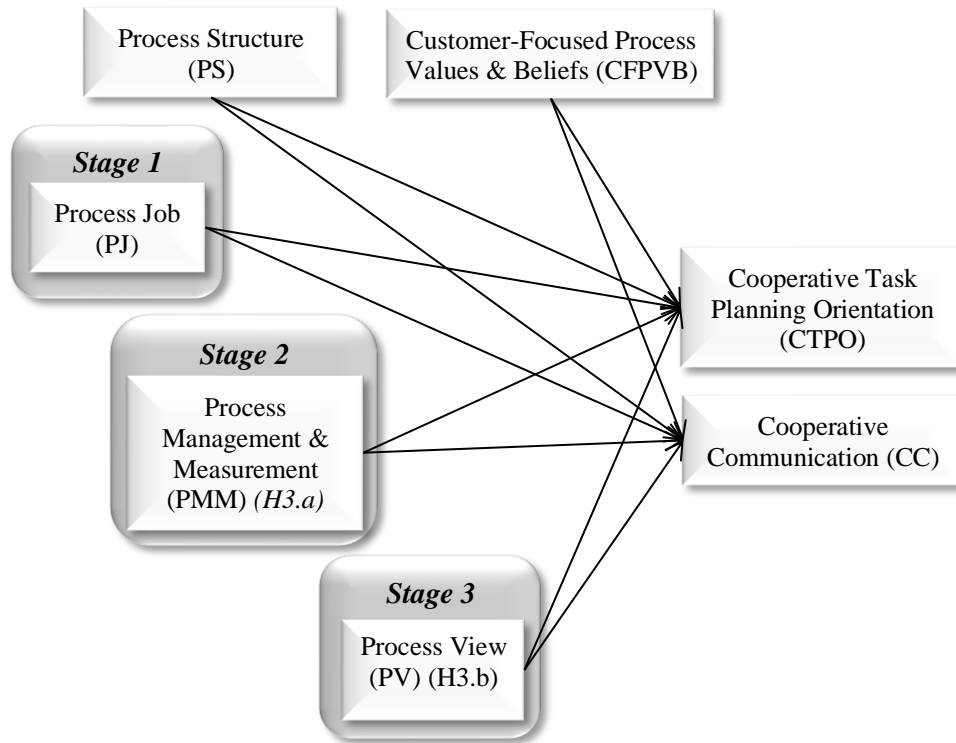


Figure 5.17. The Hierarchical Model

To test the model this research conducted hierarchical multiple regression, using SPSS. As it was discussed in Chapter Three, in the Hierarchical Model grounded on the KTPs of BPO maturity this research is interested to explore if the hierarchical development of PJ, PMM & PV, would provide a better dynamic basis underlying II than the two preceding models. In addition, each stage should be accompanied by the two supporting elements to create a foundation for the three basic elements to operate interactively.

The sequential regression model was first built for CTPO. The analysis which produced five models was conducted by adding the basic elements at each step hierarchically and the control variables (i.e. the two indicators of firm size), PS and CFPVB were also included in each stage to control for their effect. The results are illustrated in Table 5.36. In model 1 with the control variables included no significant effect was found on CTPO. The inclusion of PS and CFPVB in model 2 made a significant  $R^2$  change= 0.432, meaning that PS and CFPVB both together account for 43.2% of the variance in CTPO. Adding PJ, PMM and PV hierarchically in model 3, model 4 and model 5, respectively, also resulted in significant  $R^2$  change ( $\Delta R^2=0.023$ , 0.040 & 0.030 in model 3,4, & 5, respectively at  $p<0.05$ ). Indeed, by adding PJ in model 3 the  $R^2$  increased by 0.023, indicating that the model accounts for an additional *Sum of Square (SS)*=125.164 according to ANOVA output in Table 5.37. Moreover, the addition of PMM in model 4 resulted in an increased  $R^2$  by 0.040 which is also statistically significant at  $p<0.05$ , and the model accounts for an additional  $SS=116.029$

( $F=17.281$ ,  $p<0.05$ ). Furthermore, the inclusion of PV also resulted in an  $R^2$  change of 3% and an additional  $SS=109.136$  ( $F=17.770$ ,  $p<0.05$ ). Although, the hierarchical inclusion of these IVs showed a significant unique contribution for each variable, PJ turned out to be insignificant once PV added to the analysis in model 5. This was also in line with the Parallel and Mediation models where the results did not provide any significant evidence suggesting that PJ and CTPO are statistically related. Overall, the results showed that the hierarchical development of PMM and PV makes statistically significant contribution in explaining the variance of CTPO ( $PMM B=0.190$  and  $PV B=0.270$ ,  $p<0.05$ ), given that PJ is already developed. Thus, *hypotheses 3.a* is supported in relation to CTPO.

Table 5.36. Multiple Regression Results for CTPO

	Model 1	Model 2	Model 3	Model 4	Model 5
<b>Constant</b>	<b>4.709*</b>	<b>5.100*</b>	<b>5.104*</b>	<b>5.110*</b>	<b>5.114*</b>
<b>Annual Sales</b>	0.091	0.060	0.072	0.069	0.075
<b>No of Employees</b>	-0.027	0.093	0.076	0.055	0.060
<b>PS</b>	-	<b>0.420*</b>	<b>0.313*</b>	<b>0.249*</b>	<b>0.185*</b>
<b>CFPVB</b>	-	<b>0.311*</b>	<b>0.277*</b>	<b>0.215*</b>	<b>0.188*</b>
<b>PJ</b>	-	-	<b>0.200*</b>	<b>0.149*</b>	0.053
<b>PMM</b>	-	-	-	<b>0.257*</b>	<b>0.190*</b>
<b>PV</b>	-	-	-	-	<b>0.270*</b>
<b>R<sup>2</sup></b>	0.030	<b>0.432*</b>	<b>0.455*</b>	<b>0.495*</b>	<b>0.525*</b>
<b>Adjusted R<sup>2</sup></b>	-0.004	<b>0.406*</b>	<b>0.427*</b>	<b>0.466*</b>	<b>0.495*</b>
<b>R<sup>2</sup> Change</b>	0.030	<b>0.402*</b>	<b>0.023*</b>	<b>0.040*</b>	<b>0.030*</b>
<b>F test</b>	0.878	<b>69.322*</b>	<b>8.306*</b>	<b>15.273*</b>	<b>12.191*</b>

Note:

Model 1. Predictors: (Constant), Annual sales, No of Employees

Model 2. Predictors: (Constant), Annual sales, No of Employees, PS, CFPVB

Model 3. Predictors: (Constant), Annual sales, No of Employees, PS, CFPVB, PJ

Model 4. Predictors: (Constant), Annual sales, No of Employees, PS, CFPVB, PJ, PMM

Model 5. Predictors: (Constant), Annual sales, No of Employees, PS, CFPVB, PJ, PMM, PV

\* $P<0.05$

Table 5.37. Significance of the Regression Model Results (ANOVA Output)

Model	SS	df	Mean Square	F	Sig.
<b>1</b>	<b>Regression</b>	6.915	7	0.988	0.878
	<b>Residual</b>	222.803	198	1.125	
	<b>Total</b>	229.718	205		
<b>2</b>	<b>Regression</b>	99.223	9	11.025	16.559
	<b>Residual</b>	130.495	196	0.666	
	<b>Total</b>	229.718	205		
<b>3</b>	<b>Regression</b>	104.555	10	10.455	16.289
	<b>Residual</b>	125.164	195	0.642	
	<b>Total</b>	229.718	205		
<b>4</b>	<b>Regression</b>	113.689	11	10.335	17.281
	<b>Residual</b>	116.029	194	0.598	
	<b>Total</b>	229.718	205		
<b>5</b>	<b>Regression</b>	120.583	12	10.049	17.770
	<b>Residual</b>	109.136	193	0.565	
	<b>Total</b>	229.718	205		

\* $P<0.0$

The hierarchical regression analysis was also conducted on CC and the results are reported in Table 5.38. Similar to the results found for CTPO in model 2, the test reported that



PS and CFPVB account for a substantial variance in CC ( $R^2 = 0.585$ ,  $p < 0.05$ ). In addition, a significant  $R^2$  change was detected by adding PJ in model 3 ( $\Delta R^2 = 0.020$ ,  $p < 0.05$ ) which accounts for a  $SS = 65.259$  (ANOVA output in Table 5.39). Yet, no significant  $R^2$  change was revealed as a result of sequentially including PMM and PV into model 4 and 5, respectively. While, these findings were also evident in the Parallel Model analysis where no significant  $R^2$  change was found in CC as a result of entering PMM into the model, the post hoc analysis revealed a significant effect of PV on CC. This paradox could be attributed to the overlapping characteristics of BPO elements. Indeed, the hierarchical inclusion of PJ, PMM, and PV, respectively, might have introduced redundancy into the regression model, resulting in the lack of detecting a significant relationship between PV and CC. Nevertheless, the results did not provide evidence supporting *hypotheses 3.b*.

Table 5.38. Multiple Regression Results for CC

	Model 1	Model 2	Model 3	Model 4	Model 5
<b>Constant</b>	<b>5.668*</b>	<b>5.648*</b>	<b>5.651*</b>	<b>5.653*</b>	<b>5.655*</b>
<b>Annual Sales</b>	0.020	-0.015	-0.004	-0.005	-0.002
<b>No of Employees</b>	-0.134	0.003	-0.013	-0.022	-0.020
<b>PS</b>	-	<b>0.455*</b>	<b>0.356*</b>	<b>0.328*</b>	<b>0.296*</b>
<b>CFPVB</b>	-	<b>0.386*</b>	<b>0.355*</b>	<b>0.328*</b>	<b>0.314*</b>
<b>PJ</b>	-	-	<b>0.187*</b>	<b>0.165*</b>	0.118
<b>PMM</b>	-	-	-	0.112	0.080
<b>PV</b>	-	-	-	-	0.132
<b>R<sup>2</sup></b>	0.055	<b>0.585*</b>	<b>0.605*</b>	0.613	0.620
<b>Adjusted R<sup>2</sup></b>	0.022	<b>0.566*</b>	<b>0.585*</b>	0.591	0.596
<b>R<sup>2</sup> Change</b>	0.055	<b>0.529*</b>	<b>0.020*</b>	0.008	0.007
<b>F test</b>	1.655	<b>124.965*</b>	<b>10.020*</b>	3.793	3.604

Note:

Model 1. Predictors: (Constant), Annual sales, No of Employees

Model 2. Predictors: (Constant), Annual sales, No of Employees, PS, CFPVB

Model 3. Predictors: (Constant), Annual sales, No of Employees, PS, CFPVB, PJ

Model 4. Predictors: (Constant), Annual sales, No of Employees, PS, CFPVB, PJ, PMM

Model 5. Predictors: (Constant), Annual sales, No of Employees, PS, CFPVB, PJ, PMM, PV

\* $P < 0.05$

Table 5.39. Significance of the Regression Model Results (ANOVA Output)

Model		SS	df	Mean Square	F	Sig.
1	Regression	9.132	7	1.305	1.655	0.122 <sup>b</sup>
	Residual	156.105	198	0.788		
	Total	165.237	205			
2	Regression	96.624	9	10.736	30.669	0.000 <sup>c</sup>
	Residual	68.613	196	0.350		
	Total	165.237	205			
3	Regression	99.978	10	9.998	29.874	0.000 <sup>d</sup>
	Residual	65.259	195	0.335		
	Total	165.237	205			
4	Regression	101.229	11	9.203	27.892	0.000 <sup>e</sup>
	Residual	64.008	194	0.330		
	Total	165.237	205			
5	Regression	102.402	12	8.534	26.211	0.000 <sup>f</sup>
	Residual	62.835	193	0.326		
	Total	165.237	205			

\* $P < 0.05$

### 5.8.6. The Comparison of the Three Competing Models

So far, this research examined the propositions developed for three mutually exclusive theoretical perspectives, which were named as the Parallel, Mediation and Hierarchical Models. In this section it is sought to examine and identify the leading theoretical perspective through comparing the regression results reported in Table 5.40. As the models were tested using regression analysis, Adjusted  $R^2$  is used as the most suitable comparative diagnostic (Krueger Jr et al., 2000).

Table 5.40. The Synthesis of the Findings from the Three Competing Frameworks

Models	DVs	Adjusted $R^2$	Main significant effects (Beta coefficient)
The Parallel Model	CTPO	0.493* (PV, PMM, PS, CFPVB)	PV= 0.271* PMM= 0.190* PS=0.185* CFPVB=0.188*
	CC	0.594* (PV, PS, CFPVB)	PV=0.214* PS=0.296* CFPVB=0.314*
The Mediation Model	CTPO	0.4878* (PS effect through PJ, PV, PMM)	PV=0.2762* PMM=0.1902*
		0.4869* (CFPVB effect through PJ, PV, PMM)	PV=0.3053* PMM=0.1870*
	CC	0.5184* (PS effect through PJ, PV, PMM)	PV=0.1502*
		0.5404* (CFPVB effect through PJ, PV, PMM)	PV=0.1795*
The Hierarchical Model	CTPO	0.495* (the hierarchical effect of PJ, PMM, and PV on CTPO)	PV=0.270* PMM=0.190* PS=0.185* CFPVB=0.188*
	CC	0.596 (the hierarchical effect of PJ, PMM, and PV on CC)	PS=0.296* CFPVB=0.314*

*Note:* The main effect of PV on CC in the Parallel Model is drawn from the stepwise regression analyses performed to verify the findings from the simple regression model. \*  $p < 0.05$

Drawing upon the results it was discovered that the Parallel Model best fits the data, demonstrating a marginally higher Adjusted  $R^2$  compared to the Mediation Model (0.493 and 0.594 for CTPO and CC, respectively). Indeed, II is better predicted through the Parallel Model. Findings from the Mediation Model also indicated intriguing results, providing a full and partial support for the mediation effect of PV and PMM on CTPO. Yet, the indirect effects of PS and CFPVB through PV and PMM (PS fell out as a mediator) on CTPO decreased compared to their direct effects. As such, Adjusted  $R^2$  has also declined to some extent (from 0.493 in the Parallel Model to 0.4878 in the Mediation Model). Nevertheless, the main effects of PV and PMM on CTPO have slightly improved. For example, a small increase was detected in PV *Beta Coefficient* from 0.271 to 0.2762 once it was introduced as a mediator. Furthermore, in the presence of the three mediators the indirect relationships between PS-CC and CFPVB-CC were only mediated through PV. Counter to the increased *Beta Coefficient* identified earlier, the main effect of PV on CC decreased to some extent (e.g. *Beta Coefficient* declined from 0.214 in the Parallel Model to 0.1502 in the Mediation Model). This also followed by a decrease in the model Adjusted  $R^2$  from 0.594 (the Parallel Model) to 0.5184

and 0.5404 for PS and CFPVB, respectively. Overall, given that the Adjusted  $R^2$  obtained for II elements are statistically significant and greater than that of in the Mediation Model, the Parallel Model appears marginally superior in providing the dynamic basis underlying II.

With regards to the Hierarchical Model established on the so-called BPO maturity model and the KTPs, similar results were identified in the main effects detected in the Parallel Model. The value of Adjusted  $R^2$  marginally increased by 0.2% for CTPO in the Hierarchical Model, while it became insignificant for CC. As for the IVs individual contributions, the main effect of PMM, PS and CFPVB, also remained the same and significant, whereas a minor decrease of 0.1% (from 0.271 in the Parallel Model to 0.270 in the Hierarchical Model) was reported in the effect of PV on CTPO. As for CC, no significant difference was found, suggesting that CC is mainly affected by PS and CFPVB irrespective of the adopted theoretical perspective, i.e. either the Parallel or Hierarchical Model. However, the post-hoc analysis performed on the Parallel Model revealed that PV has a significant relationship with CC. This will be further confirmed in the following section where the moderation effect of PM on the BPO-II relationship is examined.

Having considered the Adjusted  $R^2$ s and the main effects in the three models, the Parallel model suggested to provide the most superior basis, best predicting II. In other words, the comparison analysis provided sufficient evidence that the relationship between BPO and II is better explained through the Parallel Model. Despite that theoretical research has excessively argued that BPO is not a bipolar concept developed instantaneously (Škrinjar et al., 2010), the empirical results in this research suggested that evolving through various stages of BPO maturity takes a simultaneous institutionalising of its practices. This suggests that the overlapping characteristics of BPO dimensions developed simultaneously could increase its effectiveness in providing the means to achieve II. This inconsistency could of course arise from the context-dependent nature of both BPO and II which is expected to yield varying results in different contexts. Furthermore, the data from this empirical research have been subjected to cross-sectional time horizon which is believed to have exerted limitation on shedding more light on the effect of BPO development on II over a longer period of time.

The outcome of these analyses informed the investigation of the third research question concerning the moderation effect of product modularity (PM) on the BPO-II relationship. Thereby, the moderation effect of PM is investigated on the Parallel Model in the following section.

### **5.9. Testing the Moderation Effect of PM on the BPO-II Relationship**

A moderator is defined as a variable that alters the variability in a DV through interacting with an IV, although it does not necessarily have a direct effect on the outcome

variable (Aguinis and Stone-Romero, 1997). Research in social sciences have shown different conceptualisations of interaction effects (Jaccard and Turrisi, 2003), yet, the current research adopts Jaccard and Turrisi (2003)'s approach which define it as a relationship between IVs and DVs moderated by a third variable changing the strength of this relationship. The inclusion of an interaction effect in multiple regression model could give rise to multicollinearity issue, thus mean-centring technique is used to eliminate unnecessary collinearity between interaction effects and main effects (Jaccard and Turrisi, 2003, Antonio et al., 2009). The use of this technique is recommended before the creation of the interaction terms to minimise multicollinearity (Dalal and Zickar, 2012) and avoid variance inflation (Kutner et al., 2004). This research employs moderated multiple regression (MMR) which is suggested to be one of the statistical techniques allowing for the analysis of interaction effect (Saunders, 1956, Aguinis et al., 2011).

Drawing on an extensive literature, it was hypothesised that the effect of BPO dimensions on II could vary as a function of PM variable. Therefore, this research is interested to investigate whether there is an interaction effect between BPO and PM in predicting II through testing the following five hypotheses:

**Hypothesis 4.a (H4.a -):** *“The effect of process job (PJ) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

**Hypothesis 4.b (H4.b -):** *“The effect of process view (PV) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

**Hypothesis 4.c (H4.c -):** *“The effect of process management & measurement (PMM) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

**Hypothesis 4.d (H4.d -):** *“The effect of process structure (PS) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

**Hypothesis 4.e (H4.e -):** *“The effect of customer-focused process values and beliefs (CFPVB) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”*

In testing a moderation effect, it is crucial to first ensure about the adequacy of MMR statistical power to be able to detect the hypothesised interaction effect. In their seminal study,

Herman and Ryan (2010) synthesised the best practices in MMR analysis and provided some recommendations for improving the MMR test accuracy in detecting an existing interaction effect. They argue that “MMR suffers from a low statistical power” (p.779) which could reduce the chance of identifying an interaction effect even if it exists. Therefore, a researcher could commit Type II error failing to discover a moderation effect if some measurement and design issues are not considered. The measurement issues concern predictor variables reliability and ‘scale coarseness’. Design issues refer to a negative bias in a sample to population variance and the sample size.

To overcome these issues, some pre- and post-data collection examinations were performed (Aguinis et al., 2011). Having done CFA analysis for both IVs and DVs, the high reliability of variables was established (Aguinis et al., 2011). The issue of coarseness was addressed through using seven-point Likert scale which is argued to offset the risk of information loss caused due to the lack of providing sufficient response choices (Pearse, 2011, Aguinis et al., 2011). Negative bias in sample to population variance is not expected to occur in the current research because the sample was randomly selected from the FAME database. In addition, having obtained a relatively large sample size (i.e. 215), MMR is believed to be exempt from low statistical power (Aguinis et al., 2011). Hence, MMR analysis is confirmed to have sufficient statistical power to discover the moderation effect of PM on the BPO-II relationship.

#### **5.9.1. Moderation Effect of PM on CTPO**

Two separate MMR analyses were performed for the two DVs, CTPO and CC, using SPSS, to investigate whether the association between BPO and II depends in any way on the level of PM. The first regression model included PJ, PV, PMM, PS, CFPVB, CTPO as well as five interaction terms created between PM and the five BPO dimensions. Figure 5.18 illustrates the effect of the five interaction terms on CTPO.

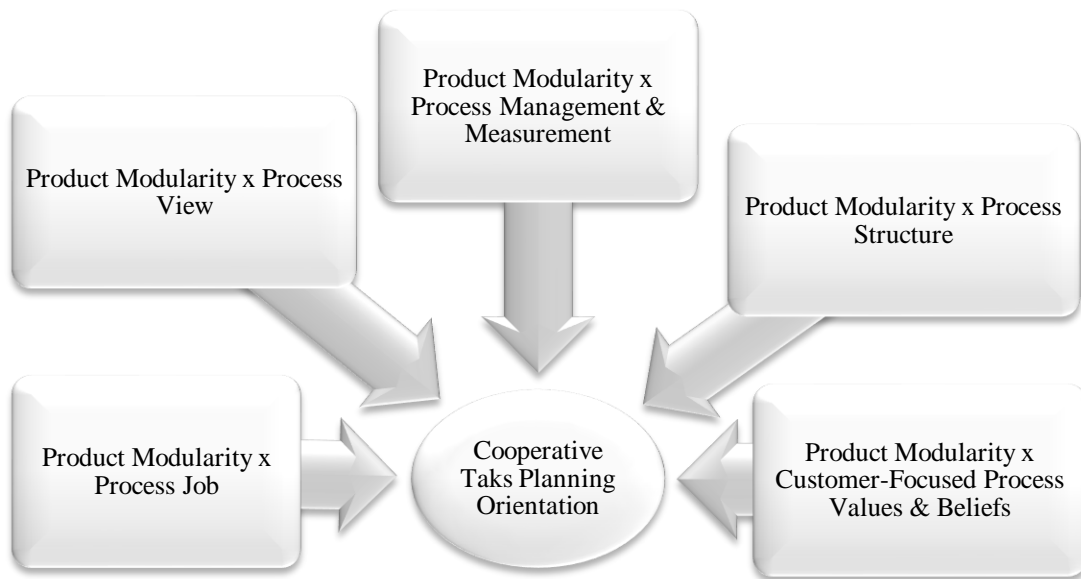


Figure 5.18. PM Moderation Effect on CTPO

Each interaction effect was introduced into the model individually (*H4.a-H.e*) as this approach helps to avoid multicollinearity which may be present when several interaction terms are included in the analysis (Aguinis, 1995, Parthasarthy and Hammond, 2002). Hierarchical multiple regression was used to control for the effect of firm size, thus seven models were generated. The VIF values were all reported to be below the desired value of 10, confirming the absence of multicollinearity issue. The examination of the results reported in Table 5.41 (Model 3 to 7) indicated that there is no significant moderation effect on CTPO, deriving from the interaction of PM with the five BPO dimensions. Thus, as the interaction terms added in each model no significant  $R^2$  change was detected, suggesting that the effect of BPO dimensions on CTPO does not change as a function of PM. Thus, *hypotheses (H4.a-H.e)* are not supported for CTPO.

Table 5.41. MMR Results for CTPO

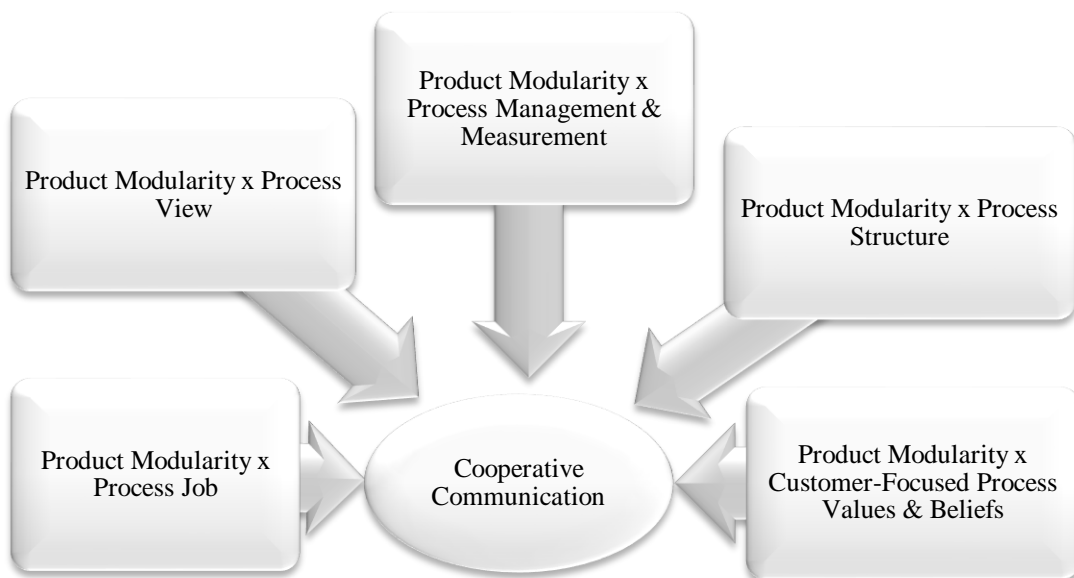
	Model 1	Model 2	Model 3	Model4	Model 5	Model 6	Model 7
<b>Constant</b>	<b>4.709*</b>	<b>4.502*</b>	<b>4.498*</b>	<b>4.499*</b>	<b>4.471*</b>	<b>4.477*</b>	<b>4.478*</b>
<b>Annual Sales</b>	-0.027	0.060	0.060	0.061	0.055	0.057	0.058
<b>No of Employees</b>	0.091	0.075	0.077	0.076	0.076	0.075	0.075
<b>PJ</b>	-	0.053	0.059	0.057	0.069	0.066	0.066
<b>PV</b>	-	<b>0.271*</b>	<b>0.269*</b>	<b>0.266*</b>	<b>0.269*</b>	<b>0.274*</b>	<b>0.275*</b>
<b>PMM</b>	-	<b>0.190*</b>	<b>0.193*</b>	<b>0.186*</b>	<b>0.169*</b>	<b>0.170*</b>	<b>0.169*</b>
<b>PS</b>	-	<b>0.185*</b>	<b>0.181*</b>	<b>0.187*</b>	<b>0.194*</b>	<b>0.191*</b>	<b>0.190*</b>
<b>CFPVB</b>	-	<b>0.188*</b>	<b>0.186*</b>	<b>0.187*</b>	<b>0.176*</b>	<b>0.175*</b>	<b>0.174*</b>
<b>PM</b>	-	-0.001	-0.009	-0.012	-0.017	-0.020	-0.019
<b>H4.a (-) PM x PJ</b>	-	-	0.029	-0.023	-0.051	-0.064	-0.064
<b>H4.b (-) PM x PV</b>	-	-	-	0.082	0.045	0.031	0.029
<b>H4.c (-) PM x PMM</b>	-	-	-	-	0.094	0.088	0.085

<b>H4.d (-) PM x PS</b>	-	-	-	-	-	0.041	0.034
<b>H4.e (-) PM x CFPVB</b>	-	-	-	-	-	-	0.017
<b>R<sup>2</sup></b>	0.030	<b>0.525*</b>	0.526	0.530	0.534	0.535	0.535
<b>Adjusted R<sup>2</sup></b>	-0.004	<b>0.493*</b>	0.491	0.492	0.495	0.493	0.490
<b>R<sup>2</sup> Change</b>	0.030	<b>0.495*</b>	0.001	0.004	0.004	0.001	0.000
<b>F test</b>	0.878	<b>33.329*</b>	0.292	1.581	1.824	0.330	0.069

*Note:* Dependent Variable: CTPO, \* at  $P < 0.05$  significance level, the regression values reported in the table are standardised coefficients

### 5.9.2. Moderation Effect of PM on CC

The second MMR analysis was conducted including the five BPO dimensions, CC and the interaction terms created between the IVS and PM. The interaction terms are illustrated in Figure 5.19.



Like the MMR conducted for CTPO, each interaction effect was entered into the model individually to mitigate the risk of multicollinearity. All VIF values fell below the target value of 10, thus the results are not affected by multicollinearity issue. The results presented in Table 5.42 denote that the only interaction terms making statistically significant (at  $p < 0.05$  level) effect on CC are ' $PM \times PMM$ ', and ' $PM \times CFPVB$ '. The introduction of ' $PM \times PJ$ ' and ' $PM \times PV$ ' into model 3 and 4, respectively, made no significant change in the  $R^2$ . While model 5 showed a significant  $R^2$  change (1.7% increase in variance) as a result of entering ' $PM \times PMM$ ' into the model, ' $PM \times PS$ ' was found to make no significant change in model 6. Yet,  $R^2$  significantly increased (1.1% increase in variance) by the addition of ' $PM \times CFPVB$ '

Figure 5.19. PM Moderation Effect on CC

into model 7. The examination of the unique contribution of each interaction effect reported

in Table 5.42 showed that as the level of PM changes by one unit, the effect of PMM on CC and CFPVB on CC, increases by  $B=0.163$  and  $B=0.139$  ( $p<0.05$ ), respectively, in model 7. As such *Hypotheses 4.c and 4.e* are not supported as the results are significant in the opposite direction from the ones initially hypothesised. This indicates that higher PM reinforces the relationship between PMM-CC and CFPVB-CC as opposed to the predicted negative moderation effect in *H4.c* and *H4.e*, respectively. In addition, drawing on these results *H4.a*, *H4.b* and *H4.d* are not supported.

Table 5.42. MMR Results for CC

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	5.790*	5.580*	5.585*	5.585*	5.539*	5.531*	5.535*
Annual Sales	-0.134	-0.020	-0.020	-0.020	-0.032	-0.036	-0.031
No of Employees	0.020	-0.002	-0.005	-0.006	-0.005	-0.003	-0.006
PJ	-	0.118	0.110	0.110	0.133	0.138	0.135
PV	-	0.131	0.133	0.132	0.137*	0.130	0.140*
PMM	-	0.080	0.077	0.075	0.041	0.039	0.030
PS	-	0.296*	0.301*	0.303*	0.317*	0.322*	0.318*
CFPVB	-	0.314*	0.316*	0.317*	0.296*	0.298*	0.291*
PM	-	0.002	0.013	0.012	0.001	0.006	0.013
H4.a (-) PM x PJ	-	-	-0.037	-0.052	-0.107	-0.088	-0.090
H4.b (-) PM x PV	-	-	-	0.024	-0.047	-0.026	-0.042
H4.c (-) PM x PMM	-	-	-	-	0.184*	0.193*	0.168*
H4.d (-) PM x PS	-	-	-	-	-	-0.062	-0.120
H4.e (-) PM x CFPVB	-	-	-	-	-	-	0.139*
R <sup>2</sup>	0.055	0.620*	0.621	0.621	0.638*	0.640	0.652*
AdjustedR <sup>2</sup>	0.022	0.594*	0.593	0.591	0.608*	0.608	0.618*
R <sup>2</sup> Change	0.055	0.564*	0.001	0.000	0.017*	0.002	0.011*
F test	1.655	47.500*	0.582	0.171	8.925*	0.966	6.107*

Note: Dependent Variable: CC, \* at  $P<0.05$  significance level, the regression values reported in the table are standardised coefficients

### 5.9.3. Post-Hoc Analysis verifying the Results of MMR on CTPO and CC

It is argued that the prediction power of detecting moderation effect is maximised when there is a main effect between the predictor and DV. In other words, the presence of a relation between the two variables increases the power of the test in detecting an existing moderation effect (Frazier et al., 2004). From the regression analysis, no significant relationship was identified between PM and the two DVs, i.e. CTPO and CC, thus a structural modelling technique was employed using AMOS to further verify the results of MMR. Jaccard and Wan (1995) suggested that in order to increase the power of the test, one can run structural equation modelling (SEM) to account for measurement error, using maximum likelihood (ML) method. Measurement error has deleterious effects that can negatively influence the statistical power of significant tests, thus leading to fail in detecting the existing moderation effects.



The SEM was created using the five centralised IVs, the interaction effects as well as the two DVs. The initial results showed some insignificant regression weights and very poor model fit, suggesting the deletion of the regression path between some of the interaction terms and the two DVs. After this data reduction, no significant moderation effect was identified for CTPO, confirming the results obtained from MMR. From a statistical perspective, the insignificant interaction effects on CTPO could be due to the correlation between BPO dimensions in the model. To further investigate this matter, a simple regression model was performed including each interaction term into the model one at a time in order to control for their correlation. The tests did not report any significant  $R^2$  change, indicating that the interaction terms had no influence on the effect of one another on CTPO, thus confirming the results obtained earlier.

The same analysis was performed for CC, and intriguing result was found. In addition to the two interaction effects identified in MMR, i.e. 'PM x PMM' & 'PM x CFPVB', PM was also found to moderate the relationship between PS and CC. The final results generated from the model indicated a very good model fit ( $X^2=13.146$ ,  $p=0.069$ ,  $df=7$ ,  $X^2/df=1.878$ ,  $RMSEA=0.064$ ,  $CFI=0.994$ ,  $GFI=0.989$ , and  $SRMR=0.0183$ ). While, the results of MMR analysis were supported, using SEM technique, it also allowed for the detection of an additional interaction effect for CC. Table 5.43 illustrates the regression weights of the interaction effects after the model improvement. It is evident that 'PM x PS' has a negative significant effect on CC, meaning that a one unit increase in the level of PM decreases the strength of the PS-CC relationship by 0.129 unit on average. This finding is in line with the predicted hypothesis (*H4.d*), suggesting that PM negatively influences (i.e. *Regression Weight*= -0.129) the positive association between PS and CC. Therefore, taken together the above findings indicated that *H4.d* was partially supported, given no moderation effect was found for CTPO. It was also confirmed that *H4.c* and *H4.e* are not supported as the results were significant in the opposite direction as hypothetically predicted. Figure 5.20 demonstrates the plot of the three significant interaction effects.

Table 5.43. Regression Weights of the Significant Interaction Effects on CC (AMOS Output)

DV	Relationship Direction	Interaction Effects	Estimate	S.E.	C.R	P Value
CC	<---	PM x PMM	0.077	0.028	2.739	0.006
CC	<---	PM x PS	-0.129	0.042	-3.096	0.002
CC	<---	PM x CFPVB	0.101	0.038	2.693	0.007

SEM also confirmed the significant association between PV and CC which was previously detected through post-hoc analysis. Taking together these findings, it can, then, be endorsed that PV makes a positive and statistically significant contribution CC, further

supporting *hypothesis 1.b*. Figure 5.21 exhibits the final results of the hypotheses testing for the Parallel Model.

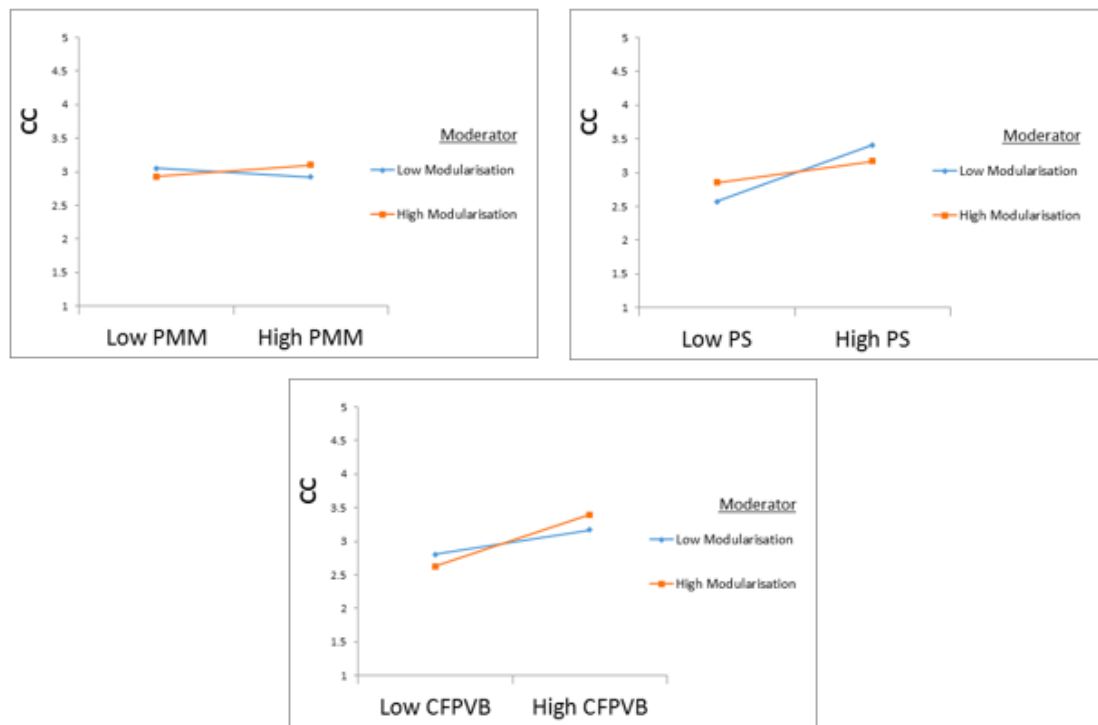


Figure 5.20. The Plots of the Significant Moderation Effects

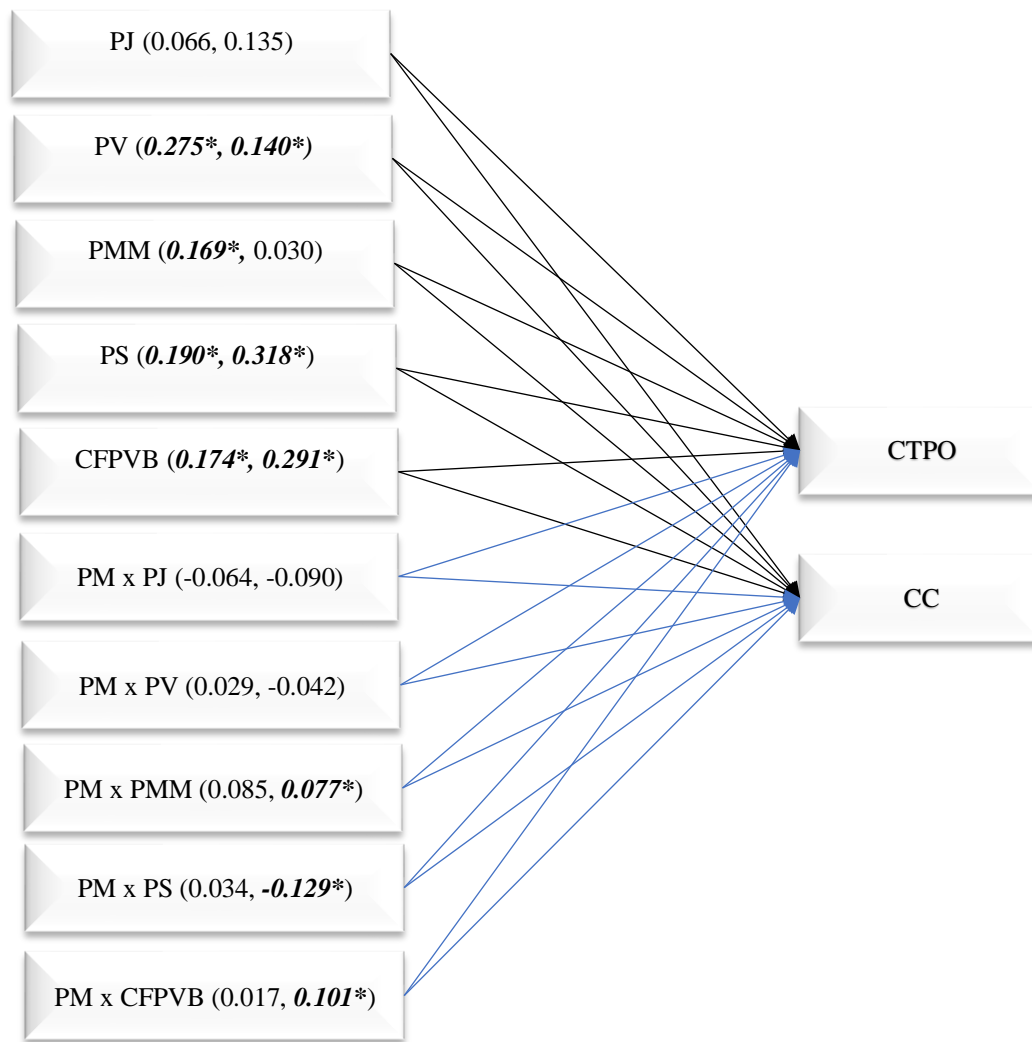


Figure 5.21. Final Results of the Hypotheses Testing

## 5.10. Summary of the Chapter

This chapter has focused on specifying the research measurement models. In order to prepare and validate the data for the main statistical analysis a detailed examination of the dataset was performed. This entailed data entry and cleaning procedure, handling missing data, missing values computation, and inspecting non-response bias, outliers and normality. For the purpose of determining the measurement constructs, factor analysis techniques, i.e. CFA and EFA, were employed. The validity and reliability of the scales (formative and reflective) adopted/adapted from the literature were then established. For the sake of answering the research questions the chapter conducted a series of statistical analyses, testing the three competing models: The Parallel, Mediation, and Hierarchical Models. This was followed by testing the moderation effect of PM on the most superior model (the Parallel Model) identified from the analysis. As such, the research hypotheses were examined through different statistical techniques, i.e. MRA and bootstrap multiple mediation analysis (MMA)

using SPSS, and SEM on AMOS. Table 5.44 provides an outline of the research hypotheses underpinning this research and the findings, drawing upon the statistical analyses. The results suggested that the Parallel Model best explains the proposed relationship between BPO and II, while most hypotheses were supported. In addition, the examination of PM moderation effect on this model offered mixed results, with two relationships being significant in the opposite direction. As a result, only one moderating relationship was supported.

The following chapter provides a detailed discussion of the research findings in relation to the literature and the theories adopted.

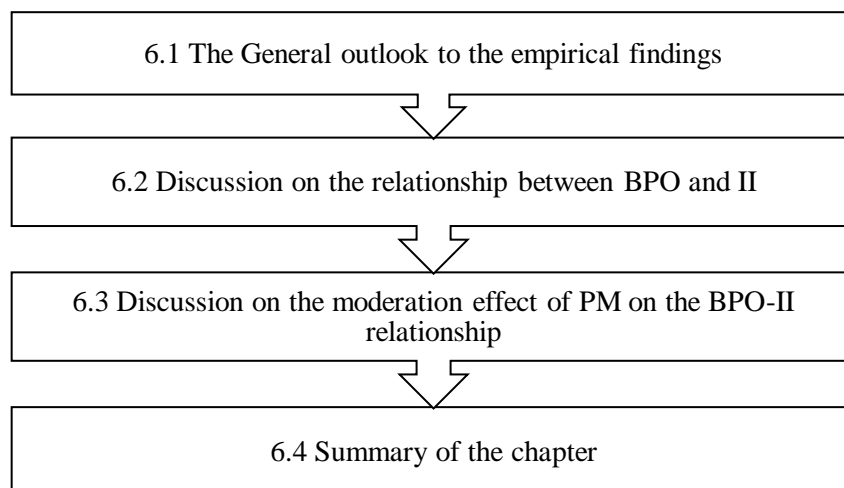
*Table 5.44. Summary of the Research Hypotheses and Findings*

<b>Conceptual Model</b>	<b>Research Hypotheses</b>	<b>Findings</b>
<b>The Parallel Model</b>	<b>Hypothesis 1.a (H1.a +):</b> “The degree of process job (PJ) has a positive impact on the degree of internal integration (II).”	Not supported
	<b>Hypothesis 1.b (H1.b +):</b> “The degree of process view (PV) has a positive impact on the degree of internal integration (II).”	Supported
	<b>Hypothesis 1.c (H1.c +):</b> “The degree of process management & measurement (PMM) has a positive impact on the degree of internal integration (II).”	Partially supported
	<b>Hypothesis 1.d (H1.d +):</b> “The degree of process structure (PS) has a positive impact on the degree of internal integration (II).”	Supported
	<b>Hypothesis 1.e (H1.e +):</b> “The degree of customer-focused process values and beliefs (CFPVB) has a positive impact on the degree of internal integration (II).”	Supported
<b>The Mediation Model</b>	<b>Hypothesis 2.a (H2.a +):</b> “PJ mediates the positive effect of PS on II.”	Supported (Complementary mediation)
	<b>Hypothesis 2.b (H2.b +):</b> “PV mediates the positive effect of PS on II.”	Supported (Complementary mediation)
	<b>Hypothesis 2.c (H2.c +):</b> “PMM mediates the positive effect of PS on II.”	Supported (Complementary mediation)
	<b>Hypothesis 2.d (H2.d +):</b> “PJ mediates the positive effect of CFPVB on II.”	Supported (Complementary mediation)
	<b>Hypothesis 2.e (H2.e +):</b> “PV mediates the positive effect of CFPVB on II.”	Supported (Complementary mediation)
	<b>Hypothesis 2.f (H2.f +):</b> “PMM mediates the positive effect of CFPVB on II.”	Supported (Complementary mediation)
<b>The Hierarchical Model</b>	<b>Hypothesis 3.a (H3.a +):</b> “PMM has a positive effect on the level of II, given that PJ is already developed.”	Partially supported
	<b>Hypothesis 3.b (H3.b +):</b> “PV has a positive effect on the level of II, given that PJ and PMM are already developed, respectively.”	Partially supported
<b>Product Modularity (PM) Moderation Effect</b>	<b>Hypothesis 4.a (H4.a -):</b> “The effect of process job (PJ) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Not supported
	<b>Hypothesis 4.b (H4.b -):</b> “The effect of process view (PV) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Not supported
	<b>Hypothesis 4.c (H4.c -):</b> “The effect of process management & measurement (PMM) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Partially supported in an opposite direction
	<b>Hypothesis 4.d (H4.d -):</b> “The effect of process structure (PS) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Partially supported
	<b>Hypothesis 4.e (H4.e -):</b> “The effect of customer-focused process values and beliefs (CFPVB) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Partially supported in an opposite direction

## Chapter Six: Discussion of the Findings

### 6. Introduction

This chapter is concerned with presenting the research findings informed by the empirical analyses performed in the previous chapter. Figure 6.1 provides a summary of the chapter structure. The chapter first outlines the key research outcomes and implications for the extant literature and practice. It then focuses on discussing the findings on the hypothesised relationships between business process orientation (BPO) and internal integration (II). This is followed by discussing the results on the moderation effect of product modularity (PM). Accordingly, the theoretical framework on both the main and moderation effects is revised. Each section also assesses the findings in terms of the extent to which they resonate with the extant literature. The chapter is ended by providing a summary of the implications of the key findings.



*Figure 6.1. Summary of Chapter Six*

#### 6.1.A General Outlook to the Empirical Findings

The overall aim of this research was to provide a new theoretical understanding of the concept of II through adopting a process-oriented approach and its interplay with the concept of product architecture. The research discussed the theoretical underpinnings and conducted empirical tests on three different theoretical models that describe the combined effect of BPO elements in providing an underlying basis of II. The research findings add some preliminary knowledge to the existing theories and evidence that argue for the significance of a process-oriented approach in the context of integration. In supporting this body of knowledge, this research carried out an empirical comparison of three competing models to explain what composition constitutes the most well-established relationship between BPO and II. Thereby, one of the key objectives of this research lied in identifying the predictive accuracy of the

alternative models. By analysing the first model (Parallel), we found initial evidence that there is a significant cause and effect relationship between BPO and II. Also, the results supported that the simultaneous development of BPO elements yields increased integration. This may suggest that the perceived complexity of this development process for organisations (Segatto et al., 2013) is simplified when accounting for the constructive dynamic created by the parallel evolution of its underlying factors. Likewise, analysing the other two competing models (i.e. Mediation and Hierarchical) showed positive effects, but the observed pattern of their coefficients and the magnitude of their factors impact on II were different. While, results confirmed their predictive power, a stronger relationship was found between BPO and II in the Parallel Model. Therefore, the Parallel Model yields useful practical applications for high- and medium-tech manufacturing firms seeking to achieve or enhance II.

In general, these findings could be explained in terms of the application of a process approach from a holistic perspective. Under process management, firms need to deal with the complexity of business processes in crafting internal systems and procedures and developing performance measures. Essentially, the successful development of a process approach resides in a holistic view to the comprehension of its tools and practices coupled with the participation of individuals to make the use them. Process approach is recognised as covering the management of behaviours as well as the practices and methods used for executing internal processes. It is argued that given its multifaceted management system and broad approach, organisational practices and resources adopted to support its activities should be developed simultaneously (Golann, 2006). For example, individuals training will not be effective in the lack of available technical resources (such as systems and procedure) to communicate with customers. Conversely, technical resources would not yield any benefit without having motivated and trained employees who follow process-oriented techniques and procedures. This implies that each aspect of process management relies consistently on the effective adoption of one another to enable the achievement of process approach overall capability. Thus, it could be argued that although each element can refer to only one attribute of BPO, it cannot result in its true effectiveness without the support of its underlying elements evolving simultaneously along each other. On that basis, the institutionalisation of its elements in parallel accounts for the holistic substance of its implementation and as such forms the most superior dynamic basis for II.

Besides, from a company size perspective, the proportion of SMEs, accounting for 85% of the sample size compared to that of only 15% of large manufacturing firms, may also have some significant implications for the results of this research. Indeed, being dominated by SMEs the company size is likely to explain the higher predictive power of the Parallel Model. It is argued that unlike large manufacturers, SMEs are greatly constrained by available resources and their allocations. Under such circumstances their decision making in regards to

the adoption of a process approach is limited due to the need for training employees, the tendency to “remain attached to functional methods of thinking and managing”, lack of sufficient employees as resources and the ability to manage the transformation process (Chong, 2014, p.43). SMEs are perceived to adopt a more organic organisation as oppose to a bureaucratic structure in larger firms (Ghobadian and Gallear, 1996). In addition, compared to large firms with a tall and multi-tier management layers, SMEs lack hierarchical complexity making a flat organisational structure and informal working relationships more appropriate in their organisations (Rao et al., 2003). On the surface, these seem to suggest that their inherent characteristics associated with their company size may preclude them from having a sophisticated BPO structure that is flexible enough to accommodate the systemic characteristics of its elements and their dynamic relationships (which are evident in the Mediation and Hierarchical models). On that account, this study contributes to the research by understanding the behaviour of a process approach in SMEs as well as large manufacturing firms, particularly in high- and medium-tech industry.

Furthermore, testing for the moderation effect of PM provided interesting and mixed findings which showed some process-based practices are more effective under certain degree of product modularity (PM). Our results lend support to some of the hypothesised relationship in the context of the BPO-II relationship. While, PM reported no moderation effect on the PJ-II and PV-II relationships, it was confirmed that the PS-II relationship could be hampered as a result of high modularity which is believed to promote a modular organisational structure. More interestingly, the results indicated a reverse moderation effect on the PMM-II and CFPVB-II relationships, partially supporting the hypotheses in the opposite direction. The impact of PM in this study provides convincing empirical evidence of the power of product characteristics to orchestrate a fit between product architecture and organisational ties, and thus drive cross-boundary interaction and communication. Although, the positive moderation effects do not directly support their underlying hypotheses, they are not inconsistent with the theoretical understanding that product architecture has consequences beyond the immediate early stage of product development at which decisions about design specifications are made. The findings, thus, shed some light for practitioners on the implications of PM for organisational structure and communication pattern in the context of process orientation. The partial efficacy of PM as a moderator variable indicated that firms pursuing a high modularisation strategy at a product level achieve more integration benefits from the BPO adoption than firms pursuing less modularisation. This argument holds true with the exception of PM negative implications for process structure. Therefore, our study contributes to extant research by emphasising product architecture as a key decision area intertwined with decisions pertaining organisational activities and supply chain (SC) ties. In particular, high- and medium-tech manufacturing firms which are more likely to experience information

asymmetry and ambiguity across development teams/functions could benefit from a better understanding of the expected outcome of high modularity.

Having conducted factor analysis, two factors were extracted for II including, Cooperative Task Planning Orientation (CTPO) and Cooperative Communication (CC). BPO was presented as comprising of three basic and two supporting elements, including (1) Process Job (PJ), (2) Process View (PV), (3) Process Management & Measurement (PMM), (4) Process Structure (PS), and (5) Customer-Focused Process Values & Beliefs (CFPVB). In addition, PM was measured as a one-factor construct using the items developed and validated in the literature and are considered to be the corresponding indicators of PM definition. With the exception of PJ, sufficient evidence was provided to support the hypothesised relationship between PV, PMM, PS, and CFPVB and the level of II. Indeed, the higher predictive power of the Parallel Model specified PV, PMM, PS, and CFPVB as four separate direct antecedents of II. Effectively, these results indicated that firms who exercised a higher level of BPO (through institutionalising the four aforementioned elements) are in a better position to promote cooperative working environment towards improving intra-firm integration. Additionally, the development of a holistic model of the links between II, BPO and PM allowed for an overarching investigation to capture contributing factors as well as outcomes of modularity in the context of integration. As such, this research contributes to the growing interest in achieving integration at an intra-firm level through leveraging process-oriented capabilities, which creates a conducive mode of management, while also accounting for the enabling and inhibiting effects of a modular product architecture. In other words, the empirical results provided evidence for our claim that it is simplistic to undermine the interdependence between product and process decision areas, given their consequences for the value chain ties. Based on these empirical findings, the primary theoretical framework developed in Chapter Three was revised and is presented in Figure 6.2. The subsequent sections provide a detailed discussion of the research findings in relation to the extant literature.



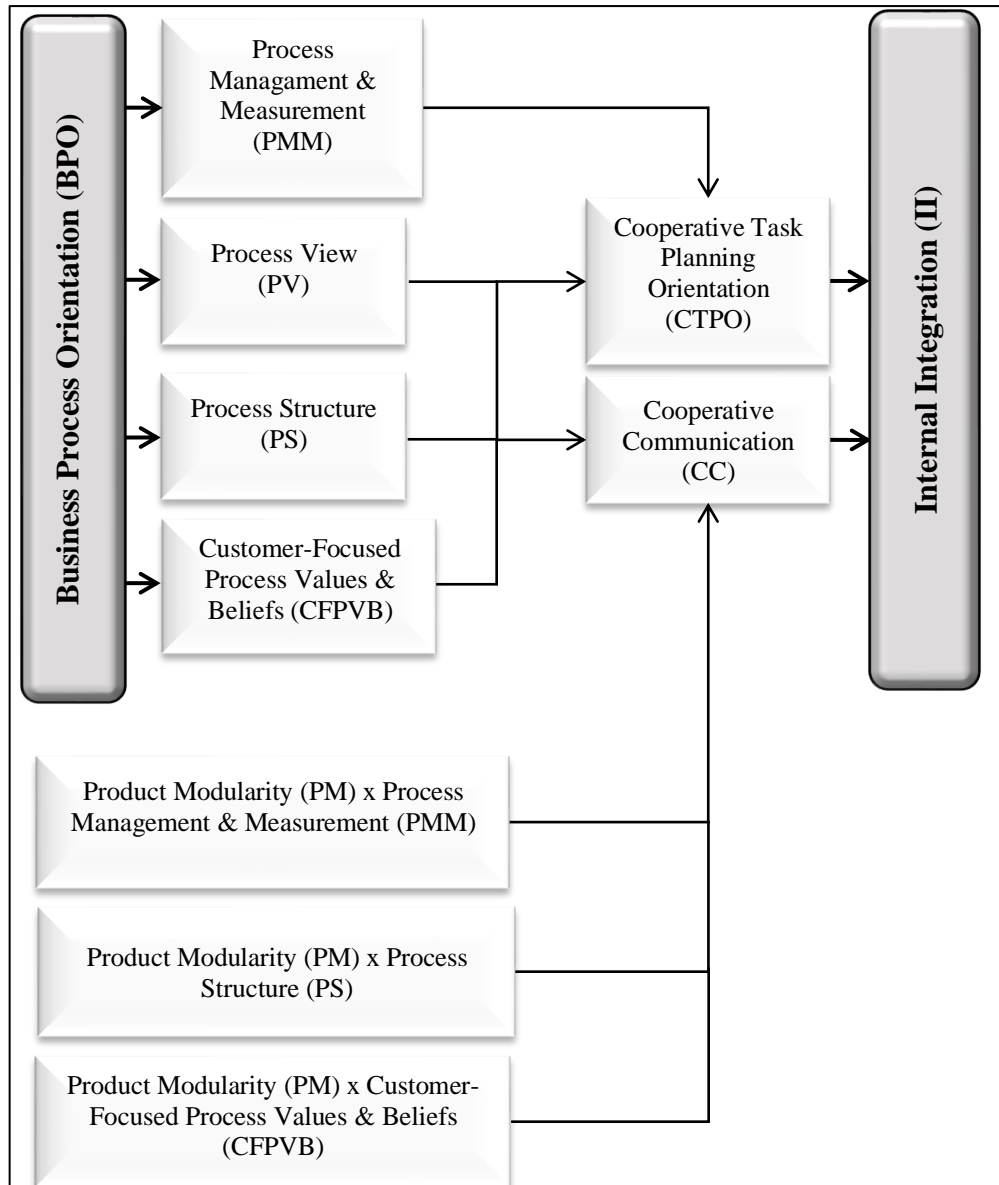


Figure 6.2. Research Revised Theoretical Framework

## 6.2. Discussion on the Relationship between Business Process Orientation (BPO) and Internal Integration (II)

This section is concerned with presenting the discussion on the hypothesised relationships presented in Table 6.1 in order to address the following research questions:

**RQ1:** “What is the relationship between business process orientation (BPO) and internal integration (II)?”

**RQ2:** “To what extent taking a process-oriented approach could provide a dynamic basis underlying internal integration (II)?”

Table 6.1. Empirical Findings on the Main Effects Hypotheses (The Parallel Model)

Conceptual Model	Research Hypotheses	Findings
The Parallel Model	<i>Hypothesis 1.a (H1.a +): "The degree of process job (PJ) has a positive impact on the degree of internal integration (II)."</i>	Not supported
	<i>Hypothesis 1.b (H1.b +): "The degree of process view (PV) has a positive impact on the degree of internal integration (II)."</i>	Supported
	<i>Hypothesis 1.c (H1.c +): "The degree of process management &amp; measurement (PMM) has a positive impact on the degree of internal integration (II)."</i>	Partially supported
	<i>Hypothesis 1.d (H1.d +): "The degree of process structure (PS) has a positive impact on the degree of internal integration (II)."</i>	Supported
	<i>Hypothesis 1.e (H1.e +): "The degree of customer-focused process values and beliefs (CFPVB) has a positive impact on the degree of internal integration (II)."</i>	Supported

The significant relationships found between BPO elements and II factors are demonstrated in Figure 6.3.

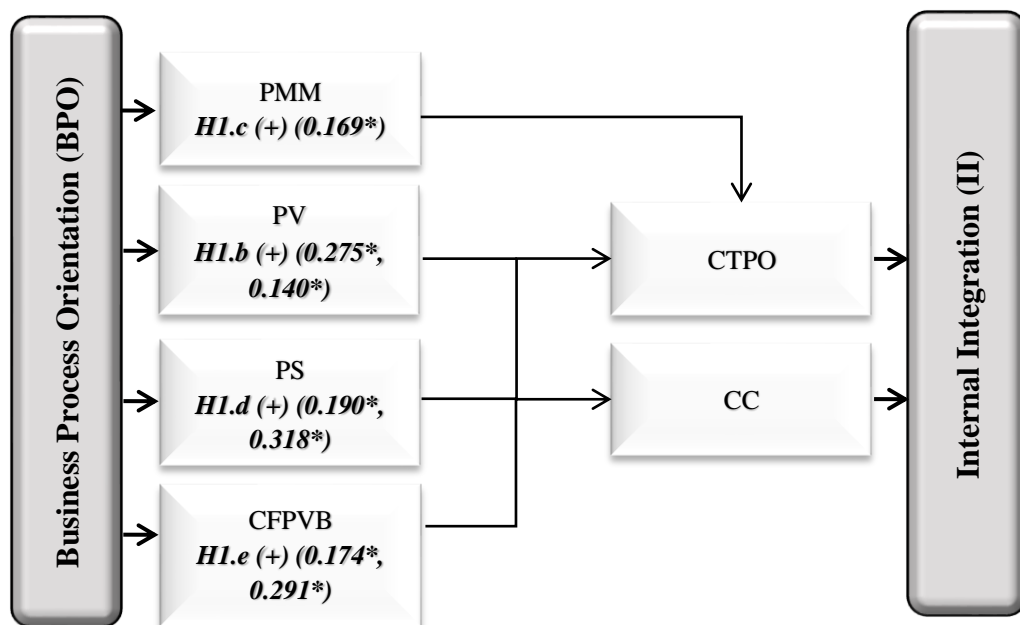


Figure 6.3. Significant Main Effects of BPO Dimensions and II Factors

Our data analysis provided support that BPO constitutes a firm dynamic basis underlying II, confirming that BPO dimensions could predict a fairly significant percentage of the variance in both CTPO and CC. Generally speaking, these findings could be positioned in a theoretical debate about the relationship between BPO and an organisation's intangible assets, i.e. social capital (Llewellyn and Armistead, 2000, Kujansivu and Lönnqvist, 2008, Zarei et al., 2014). This body of literature has investigated the implications of process approach for cognitive, structural and relational aspects of social capitals and presented evidence suggesting that the development of BPO could lead to the enhancement of intangible

capitals through reinforcing company-wide cooperation/communication and customer orientation (Zarei et al., 2014). Hence, BPO can be regarded as a tool or method to achieve II. Meanwhile, the parallel development of its underlying elements yields the best outcome in the context of the current research.

Nonetheless, the findings did not provide sufficient evidence substantiating some hypotheses which may be attributed to the following reasons. The development of BPO is of a progressive nature involving several steps before it leads to an extended and integrated SC (Lockamy III and McCormack, 2004, McCormack and Rauseo, 2005). Thus, in general, the lack of finding empirical support could be mainly related to the BPO development stages at which the firms were operating at, at the time of their participation. Besides, the context in which BPO and integration are executed could have some implications for the results too (Ravesteyn, 2009, Turkulainen and Ketokivi, 2012, Vom Brocke et al., 2016). In this sense, as already discussed in the previous section, the organisational size may also be a determinant factor explaining the research outcome.

Literature has frequently demonstrated that process orientation has a positive impact on business performance (Anderson et al., 1994, Ittner and Larcker, 1997, Frei et al., 1999, McAdam and McCormack, 2001, Reijers, 2006, Tang et al., 2013). For instance, having conducted an extensive literature review Kohlbacher (2010) revealed that process orientation entails a wide range of organisational performance improvement including customer satisfaction, reduced cycle time, financial performance, etc. In addition, a research by Schima and Schmelzer (2004) reported process transparency as one of the major implications of BPM implementation. Likewise, Reijers (2006) suggests that process orientation improves processes transparency, thus facilitating business operations. There are, though, some evidence of contradictory results in empirical research showing that process orientation has varying effects depending on the size and context of an organisation (McAdam and McCormack, 2001, Gustafsson et al., 2003). For example, McCormack (2001) suggested that process orientation promotes a sense of community by improving 'esprit de corps' and minimises cross-functional conflicts in small manufacturing firms. Whereas, Gustafsson et al. (2003) showed similar results in large service organisations, suggesting that BPO is probably not seen as a necessary and important approach unless in a firm that is large enough to utilise its benefits. While, it was argued that firm size may have some implications for the predictive power of the three competing models, this statement does not seem to apply to the association between the individual elements of BPO and II factors as no significant difference was found between SMEs and large manufacturing firms in this regard. Nevertheless, other external contextual factors to this research (i.e. functions geographical proximity) are likely to alter or influence this prediction.

### **6.2.1. The Effect of Process Job (PJ) on Internal Integration (II)**

The research results revealed that PJ has no significant main effect on the level of II, and thus *H1.a* was not supported. Grounded on the results PJ does not seem to account for the variance in the two II factors (i.e. CTPO and CC). PJ requires an understanding of process ownership and cross-functional jobs structure which should be promoted by the managers. The lack of significant effect on integration of PJ suggests that management commitment to assigning process owner and promoting cross-functional job structure does not necessarily provide a dynamic basis promoting II. This indicates that it is not a point of departure for successful adoption of a BPO aimed for promoting II. Therefore, this finding shows that the relationship between PJ and II may be dynamic, suggesting that PJ per se is not sufficient to master integration. Similarly, Kohlbacher (2013) and Kohlbacher and Gruenwald (2011a) verified that the scopes of PJ dimension must be incorporated with other process-oriented dimensions to secure organisational benefits. In support of this, Nesheim (2011) suggested that in complex organisations in which processes are likely to span several distributed functional units the role of process owner should be supplemented by a line manager whose coordination tasks are hierarchical.

One of the main tasks of a process owner is standardisation of work processes. In a process-based organisation which is likely to adopt a matrix-like structure process standardisation might be in conflict with flexibility required to balance the requirements of cross-units processes with that of a line manager roles in function-internal processes. Empirical evidence has shown that too much standardisation could obstruct flexibility and result in time-consuming and, unnecessary, process description (Golann, 2006). This situation is particularly critical in SMEs which are characterised with less management levels and standardisation and establish more informal working relationships (Rao et al., 2003, Hernaus, 2008b). Although, these may imply that a negative influence of PJ should have been expected, large firms seem to be more prone to these consequences. In fact, given that the dominant participating firms were SMEs the results may suggest that PJ is not a common practice among smaller firms to promote II as these firms have limited managerial skills (Zhang et al., 2006). Furthermore, management level execution of PJ and the need for the top manager's involvement at different stages of process maturity may also accompany the organisation size considerations. It is argued that firms who are in an early stage of process orientation are more likely to assign senior executives to process management responsibility, whereas those with more pervasive process approach are considered to be at later stage of process thinking in which process managing responsibilities are propagated across lower levels management (Hernaus, 2008a). This situation is particularly more likely to be present in larger firms with multiple management ladders than smaller firms in which the role of process owner is assigned to one person due to the absence of hierarchies.

Although, on the surface the above finding may appear to be inconsistent with the relevant literature suggesting that PJ promotes inter-functional communication and interaction due to its cross-functional nature (McCormack and Johnson, 2001b, Lockamy III and McCormack, 2004, McCormack, 2007, McCormack et al., 2009), it should be interpreted with cautious given the foundational role of PJ highlighted by some past scholars (Kohlbacher and Gruenwald, 2011b, Kohlbacher and Reijers, 2013). For example, Kohlbacher and Reijers (2013) who studied the impact of process approach on a firm competitive advantage did not find an individual effect between PJ and the firm performance. They argued that while this evidence may indicate the lack of a direct relationship, process owner role and process documentation may still provide the basis for other BPO dimensions. Research into process maturity has also advocated this view and recognises it to underpin the fundamental stage in advancing on the maturity continuum towards an extended and integrated SC. Our empirical results from the Hierarchical Model further endorse this argument, thereby, this research argues that despite the lack of significant relationship the foundational role of PJ must not be underestimated and needs further investigation in future studies.

Drawing on the contextual factors, geographical proximity of functional entities could lead to a slightly different perspective on the findings. High- and medium-tech manufacturing firms are actively involved in innovation and increasingly experience product evolution. Thus, individuals/functions need to be constantly updated on information structure and communication channels (Henderson and Clark, 1990). These updates/changes should be effectively communicated (Colfer, 2007) by the executive and management team across key business processes and value-adding activities (Harmon, 2010). As such, these business environments experience a more dynamic and “complex sociotechnical systems involving cognitive elements and [require] face-to-face negotiations and conversations” (Wieland et al., 2016, p.207). Due to their size and task complexity these firms tend to centralise their key functions in one location. For example, they mostly have a centralised R&D centre located in geographical distance from other key functions such as sales & marketing, manufacturing site, etc. Although, previous research has shown a positive effect of PJ on cross-functional integration in high- and medium-tech manufacturing firms (Tang et al., 2013), it can be argued that physical distance could potentially blur the effective role of a process owner, which may result in operational discontinuity (Roth et al., 1991), functional orientation, etc. (McCormack and Johnson, 2001b). In a similar context, Mohrman (1999) also argues that the inherent dynamics and constant changes in today’s business environments have forced some organisations to locate their operations geographically in distant locations in order to be close to and leverage distributed knowledge and expertise, which consequently make the task of cross-functional integration more challenging. Therefore, although the role of management and senior executive is argued to be substantial in supporting the process programme and

potential process ideas in a process-oriented organisation (Hammer, 2007, Kohlbacher, 2010), the findings suggest that it is likely that PJ is not utilised to promote II in high- and medium-manufacturing firms who are more likely to have distributed functions.

Besides, the adoption of varying scales may have some implications for the research findings. Indeed, it is most likely that incompatible results are obtained at different scales operationalisations (Hinkin, 1995). For example, Tang et al. (2013) measured PJ using three scales of jobs multidimensionality, problem solving, people's learning, while they were removed from the measurement model of this research due to their low reliability (Forza, 2002). This resulted in a different measurement model rather representing the importance of the management commitment to promoting cross-functional jobs structures as well as process ownership. The scales relevance and appropriateness of the current research was determined based on the contextual factors (Oliveira et al., 2015) which were extensively discussed in Chapter Four. This research went beyond selecting only those measures originally developed by McCormack (1999) and adopted a wider range of scales with different approaches operationalised for BPO dimensions in the recent studies (see Appendix 4.2). The rationale was to cover the fundamental aspects of the research context and add more robustness to the measurement model, thus rendering the dimensions measurable. It is believed that both the original items mentioned earlier as well as the management commitment aspects are the foci of scales adopted to represent PJ and are issues which should be considered when it comes to integration in the future studies.

#### **6.2.2. The Effect of Process View (PV) on Internal Integration (II)**

The research findings attested that PV plays a significant role in providing a dynamic basis underlying II. This element of BPO has emerged as an important indicator promoting II. Based on the findings a change of one standard deviation on PV yields a 0.275 and 0.140 standard deviation increase in CTPO and CC, respectively. Therefore, *H1.b* was fully supported. PV is concerned with the degree to which management is committed to stimulate a process vision and communicate consistent objectives through training. It also includes the provision of an end-to-end process modelling documentation, the definition of roles and responsibilities and their value contributions to customers, and maintains employees' job clarity and process transparency through their enhanced acquaintance with process elements and complexities (Lee and Dale, 1998, Kohlbacher and Gruenwald, 2011b, Tang et al., 2013).

Precisely, the findings indicated that a change of one standard deviation on PV is associated with a larger difference in CTPO than CC, meaning that PV mainly influences CTPO aspect of II. Thus, despite the positive association of PV and CC this effect is limited to account for a smaller degree of change in II. This was expected given the focus of both PV and CTPO constructs resting on individuals' approach, orientation and mindset towards

business processes. In other words, PV mainly targets that aspect of integration which focuses on aligned orientation towards process goals and objectives, while reorienting individuals attitudes from focusing on departmental/functional efforts to process-oriented, and thus cross-functional performance objectives. This results in sharing overarching goals and enables employees to conceptualise their tasks and responsibilities in relation to the scope of business processes. In line with this argument, empirical research has also provided evidence supporting that shared goals developed through process approach provides the ground and the context to establish a sense of community which allows employees to understand “their daily activities as contributing to a business process” (Llewellyn and Armistead, 2000, p.231). The degree to which this understanding is developed among employees is critical and underpins their perception of their roles and responsibilities. Similarly, the degree to which their responsibilities are well-defined and communicated in relation to key processes and business goals by the management is also important (Pourshahid et al., 2008) and determines the level of their collective efficacy. This ability affects individuals willingness for cooperative communication (CC) and building strong inter-personal relationships through promoting collective action and increasing the emergence of employees participation in organisational decision-making process (Kahn and Mentzer, 1998, Ellinger, 2000). This may arise from perceived goals interdependence which prompts a sense of companionship and lessens the chance of self-interested behaviour resulting in the lack of communication and isolation (Holland et al., 2000). In a similar vein, it is argued that those who are high in group efficacy are more likely to participate actively when presented with decision making opportunities in an attempt to boost their team performance (Lam et al., 2002).

These results can be positioned in the theoretical debate discussed in Chapter Two and are consistent with the research stream which underlines that PV creates a cross-functional and horizontal picture of an organisation, increasing the clarity in business processes and eliminating the element of ‘out of sight, out of mind’ (McAdam and McCormack, 2001, Lockamy III and McCormack, 2004). Additionally, through the use of modelling and mapping techniques and visual representation for the creation of processes boundaries and interrelationships, PV helps to establish a common language among individuals facilitating their communication (Smart et al., 2009). Therefore, this study reinforces the significance of PV in providing the basis that is conducive for a higher II. This could explain that in firms where employees are not familiarised with process definition and documentation, do not receive appropriate training for process view, and their roles are ill-defined in relation to a broader process, they are more likely to have a weak understanding of their work from end-to-end perspective. This prevents them from communicating with other process participants and reflecting on the overall process execution and outcome (Kettenbohrer et al., 2016). Under such circumstances, it is argued that the odds of a well-established cross-functional

communication and interaction are not strong. The lack of PV seems to have more severe consequences for high-and medium-tech organisations. It is argued that the need for higher integration is much more pronounced in high- and medium-tech manufacturing firms due to their environmental dynamics (Galbraith, 1973, Galbraith, 1977, Troy et al., 2008), uncertainty and instability. These prompt the need for leveraging cross-functional knowledge and expertise leading to uphold a cross-functional operational system. As such, given processes interdependency a higher level of transparency is required in such situation which is achieved through defining processes and their performance specifications. It has been suggested that increased goals transparency achieved through visualisation could greatly impact employees commitment and efforts on the pursuit of goals (Cheema and Bagchi, 2011). The ease of goals and tasks interpretation in a consolidated manner which is reflected in process view aspect of BPO has a strong influence on the level of employees engagement and their individual performance. Therefore, this research suggests that through the adoption of a PV these firms are expected to be able to provide a better foundation for II.

### **6.2.3. The Effect of Process Management & Measurement (PMM) on Internal Integration (II)**

Under this research, the direct relationship between PMM and II was empirically tested. The findings demonstrated a significant positive relationship between PMM and CTPO, confirming that process-oriented performance measures provide an underlying basis of II when it comes to aligning individuals' orientation. However, no significant relationship was found between PMM and CC. This observation raises the question of whether a process-based measurement system per se is sufficient to promote cooperation. Therefore, *H1.c* is partially supported. Despite being expressive, PMM showed to have the smallest overall magnitude of impact on II, accounting for only 16.9% of standard deviation increase in CTPO. This indicates that with every increase of one standard deviation in PMM, CTPO rises by 0.169 standard deviations. Therefore, the results endorse the significance of PMM within the context of BPO adoption, and in particular highlight the contribution and merits of a process-based measurement system in achieving a unity of purpose and the elimination of silos mentality. PMM is conceptualised as the measurement and management of processes based on some pre-defined measures complying with a firm's ultimate business goals (Coelho and Augusto, 2010). At the heart of PMM is process performance and evaluating the level of employees commitment to process outcomes (McCormack, 2007, Willaert et al., 2007).

While, our finding on the main effect concurs with the evidence from the BPM literature (e.g. Willaert et al., 2007), the non-significant result does not sit within the theoretical debate suggesting that a process measurement system promotes cross-functional communication and interaction (Sinclair and Zairi, 1995, McAdam and McCormack, 2001,



Tang et al., 2013). Literature has repeatedly emphasised the negative effect of poor measurement system on cross-functional integration (e.g. Pagell, 2004, Tang et al., 2013). It has been argued that business functions usually tend to emphasise on maximising their functional return in the absence of process metrics. As such, they may fail to appreciate the cooperative activities at the expense of improving functional level performance (Beretta, 2002, Tang et al., 2013). According to Pagell (2004), functional oriented measures have negative implications for integration, causing cross-functional conflicts as well as driving incompatible behaviours. In a process-oriented organisation which addresses the linkage between the articulation of strategic intent and business activities, process performance measures mainly drive business functions objectives. Hammer (2007) argues that in firms where efforts and contributions are considerably recognised through performance measurement a strong sense of meaningfulness is created among employees. He, then, suggests that one way to align separate functional units is through changing the focus from functions to process measurement. The outcome of such approach gives an impetus to avoid sub-optimisation (Willaert et al., 2007, Tang et al., 2013). This could explain that firms emphasising on process level measurement system are less likely to encounter incompatible goals, and are enabled to promote aligned mind-set and cooperative orientation (McCormack and Johnson, 2001b).

The non-significant result could be explained by drawing on our previous arguments on the complementary relationship between PMM and PJ to achieve the desired outcome of BPO adoption in the face of its contrast with the existing literature (e.g. McCormack and Johnson, 2001b, Tang et al., 2013). Research has debated that the sole implementation of either PMM or PJ is not sufficient to reap the benefit of process management, suggesting the possibility of a dynamic relationship between the two variables (e.g. Kohlbacher and Gruenwald, 2011b, Glavan, 2011, Wieland et al., 2015). For example, Kohlbacher and Gruenwald (2011b, p.711) argue that, while process measurement system “allows for tracking current process performance and [...] the identification for improvements”, a process owner who is accountable for process metrics must also be in place to drive process enhancement. They showed that firms jointly implemented both PMM and process owner role outperformed those which employed each element exclusively. It could then be argued that the effect of either PMM or PJ pales into insignificance in the absence of one another. Therefore, the observation may suggest that given the multifaceted and complex nature of PMM development (Glavan, 2011) its interaction with other elements of BPO which provide the inputs to deliver the intended results is paramount for success in inter-functional cooperation. Nevertheless, the issue of what element should interact with PMM to result in a higher CC deserves further investigation, given that the concept of BPO is still in its infancy compared to more advocated SCM practices.

#### **6.2.4. The Effect of Process Structure (PS) on Internal Integration (II)**

The empirical results demonstrated that there is a significant relationship between PS and II. Both elements of II, i.e. CTPO and CC, are positively influenced by the level of PS, thus *H1.d* was fully supported. Indeed, the findings suggest that PS provides an organisational structure in which high cooperative orientation and communication could be attained. These findings are in line with the research stream in the SCM literature (Vickery et al., 2003, Pagell, 2004, Barratt, 2004, Barki and Pinsonneault, 2005, Ellinger et al., 2006, Bakker et al., 2012, Wisner et al., 2014, Eriksson, 2015b) which focuses on the importance of organisational structure as a potential barrier to II, suggesting that integration is enhanced when organisational and decision-making structure is decentralised through the seemingly flow of information across functions. Given its significant overall magnitude of impact on II (50.8% of standard deviation increase in II including 19% and 31.8% in CTPO and CC, respectively), this research reinforces the importance of the PS in providing a dynamic basis which serves as a means to nurture II. This may potentially explain that a pure functional or centralised organisational structure obstructs the chance for cooperative task planning orientation among employees, and as a result their cooperative communication is hampered.

In general, the positive impact of PS on II is certainly positioned within the definition of a process-based organisational structure which denotes “the multidimensional [and] cross-functional authority” in a firm (McCormack and Johnson, 2001, p.41). These also reflect the most widely accepted qualities of II (i.e. cross-functional joint activity development and decision-making). Given the conceptualisation of PS as an end-to-end (system-wide) business structure (McCormack et al., 2009) the results suggest that through providing a cooperative structure among employees BPO enhances collaborative joint activity and decision making. Research has advocated that “the creation of cross-functional team around key value-adding processes is [a] [...] common organisational response” to increasing pressure to improve flexibility capability (Holland et al., 2000, p.232). In fact, it is argued that firms intangible competencies (here CTPO and CC) lie in their organisational structure, processes and individuals interdependence embedded within these processes. It is logical that research acknowledged that a general absence of commitment to integration is rooted in organisation’s structural restriction (Smith 1996) as well as the lack of “interdisciplinary communication expertise” (Thøger Christensen et al., 2008, p.427). Therefore, in line with the literature, the results explain that team-based accountability (promoted through PS) encourages employees to take an end-to-end approach to operations as opposed to their functions piece and reinforces mutual trust, the willingness to collaborate towards conflicts resolution and maximising outcome, team cohesiveness, and the recognition of collective action. Prior empirical works (e.g. Davenport et al., 1989, Bowersox et al., 1999, Srivastava et al., 1999, Mentzer, 2001, Lambert et al., 2005) conducted to highlight the importance of key business processes for

developing SCM frameworks , i.e. GSCF and SCOR, clearly substantiate the relationship between an organisational structure and a firm's operations, providing a general support for the PS-II relationship. Nevertheless, contingency theory provides a more concise explanation for these findings.

According to structural contingency theory, organisational-level strategy is influenced by the organisational and individuals work and decision-making structure. It is argued that in unstable and dynamic environments a divisional structure performs better than a functional structure (Hollenbeck et al., 2002). The functional structure operates better with undiversified strategy, while diversified strategy underpins the divisional structure (Donaldson, 2001). In high- and medium-tech manufacturing firms with more complex and dynamic environments the adoption of functional structure is more prone to suffer from a lack of cross-functional coordination, due to its hierarchical coordination tasks (Hobday, 2000, Nesheim, 2011). In addition, the consequence of such functional structure could be more detrimental in these firms due to the complex contingencies which demand more flexibility in operations (Hollenbeck et al., 2002). Such firms tend to organise tasks and responsibilities around products/project rather than functional specialities with a key focus on customers. In other words, decision-making power and authority are decentralised, offering more flexibility that is needed with emerging obligations (Bahrami and Evans, 1989). It is argued that the use of a rigid and centralised structure for the purpose of embracing the challenge of environmental complexities could exacerbate the hurdle of activities control and "may also be an oxymoron in organisations that value mutual trust and commitment" (Thøger Christensen et al., 2008, p.437). Implied in a process-based structure is the notion of multi-dimensional and cross-functional authority which is vital in such firms given the span of employees' involvement. Therefore, by allowing individuals to operate more easily under a shared decision making and action taking system, it stimulates mutual trust, commitment, participation and information exchange.

It should be recalled from Chapter Three that PS does not mean a pure horizontal organisational structure which is "in conflict with the driving principle of specialisation" (Willaert et al., 2007, p.8). But a matrix-like organisation is more likely to be adopted in such firms to strike a balance between specialisation needs (resulting in functional tasks organisations) and the importance of the value chain cutting across several functions/departments (which is at the heart of a horizontal/process organisation) (Nesheim, 2011). These are inherent necessities in these business environments dealing with multiple products/markets and technologies (Bahrami and Evans, 1989, Hobday, 2000). Nevertheless, PS is expected to be the leading adopted structure in such manufacturing firms given that integrated communication and participation are best cultivated in a boundary-spanning structure. Yet, the extent to which each structure is adopted in such firms is beyond the scope

of this research and is yet to be investigated (Willaert et al., 2007). Therefore, the positive relationship between PS and II is particularly relevant in these manufacturing firms due to their high cross-functional interdependencies. In fact, PS provides the flexibility required in such firms as well as cross-functional access to knowledge and resources, and considerably contributes to the growth of intra-firm integration.

#### **6.2.5. The Effect of Customer-Focused Process Values & Beliefs (CFPVB) on Internal Integration (II)**

This study empirically tested the direct relationship between CFPVB and II. The findings demonstrated a significant positive relationship between process-oriented culture and II. This could explain that higher level of CFPVB reinforces higher cooperative task planning development and communication, i.e. CTPO and CC, thus *H1.e* is fully supported. By and large, these findings can be positioned within the theoretical debate discussed in Chapter Two and are consistent with the research stream underlying that the lack of employees efforts supporting a process-oriented culture is hindrance to process management efforts (See for example Schein, 1990, Zairi, 1997, Abdul Rashid et al., 2004, Kavanagh and Ashkanasy, 2006, Paim et al., 2008, McCormack et al., 2009). In other words, they provide empirical supports for the BPM literature which has broadly emphasised the element of culture as a critical success factor for BPO adoption (Kohlbacher et al., 2011, Hribar and Mendling, 2014, Jurczuk, 2016). Further the results inform directly upon social capital developed through collective mind-set, shared values and beliefs and forms strong cross-cutting relationships required for collaborative action (Llewellyn and Armistead, 2000, Kujansivu and Lönnqvist, 2008). CFPVB showed a higher impact on CC (0.291) compared to CTPO (0.174) indicating that through the adoption of BPO, process culture results in 0.291 and 0.174 standard deviations increase in CC and CTPO, respectively. In fact, people play a vital role in facilitating the transition from a functional- to a process-based management structure. This means to emphasise that the focus on an organisational culture that accommodates process approach practices (Zairi, 1997, Willaert et al., 2007) plays an important role in determining the effect of process approach on II.

Unlike several previous studies that excluded this cultural element from their BPO conceptualisation (e.g. Willaert et al., 2007, Škrinjar et al., 2008, Škrinjar et al., 2010, Tang et al., 2013) the current research contended that process culture has the greatest overall magnitude of impact on II after PS compared to other dimensions. Theoretical and empirical research has generally agreed on the significance of organisational culture in decision making within the context of operations management (OM) (Braunscheidel et al., 2010). In particular, several studies confirmed that cultural aspect of an organisation is the root cause of problems concerning integration (e.g. Pagell, 2004, Gino and Pisano, 2008, Bendoly et al., 2010, Bakker

et al., 2012, Croson et al., 2013, Tangpong et al., 2014). For example, research has shown that collective culture can generate more cooperative behaviour than individualistic cultural approach (Parks and Vu, 1994). While economic incentives are believed to partially drive cross-functional cooperation, there is also key social aspects that hold individuals together. These social aspects underline II upon which human interaction and communication are grounded (Sweeney, 2013). In support of this, literature has widely argued that organisations must look beyond just the operational aspect of the SC and further heighten a sense of community and cooperative conduct among employees, emphasising the significance of their behavioural dynamics (Storey et al., 2005, Ellinger et al., 2006, Bakker et al., 2012, Tangpong et al., 2014, Wieland et al., 2016). The typical argument goes that the cultural values that are not consistent with management practices cannot provide a fertile ground on which organisational activities can effectively be coordinated (Schmiedel et al., 2019). Our findings support this line of argumentation that the application of BPO creates a prevailing organisational culture supportive of process values, attitudes and behaviour and significantly contributes to individuals thinking through a change in structure (Vom Brocke and Sinnl, 2011). It then “[provides] a general inner orientation for everyone involved (p.367). Therefore, given that people with established collective culture place more emphasis on shared values and beliefs and cooperation, they are likely to hold more appeal to cooperate among common interests.

It is argued that the development of BPO accounts for both invisible values and visible actions which are strongly interrelated (Schein, 2016). Indeed, upon an understanding of and the development of invisible process values and beliefs, a change in the actions of employees (such as visible behaviours and manners) on the entire company is followed by to achieve structural change (such as organisational charts and physical environment). Values such as consistency and customer orientation derived from CFPVB play a key part in aligning cultural diversity and defining functions direction towards corporate values of an organisation. According to McCormack and Johnson (2001b), such values, which lie in people understanding of process approach and are manifested in an organisations strategies and structure (Vom Brocke and Sinnl, 2011), provide a mechanism by which a firm can secure a close relationship with its internal and external customers. These values and norms are recognised as internal cultural preferences that focus on people development within an organisation. Firms characterised by such values are likely to cease authoritative boundaries between employees for the purpose of promoting self-autonomy and responsibilities (Alibabaei et al., 2010, Baird et al., 2011). Empirical studies have shown that organisations that follow the logics of internally-focused culture concentrate on participation, openness and commitment to teamwork (Buh, 2016). Therefore, this research suggests that creating linkages across functions which is a prerequisite for integration requires the culture of shared value and

beliefs which can be promoted effectively by a process culture, as well as the aforementioned significant underlying factors (i.e. PV, PMM and PS). This can explain that CFPVB may mitigate the risk of disharmony across functions, providing a firm basis nurturing II.

Process culture particularly plays an important role in high- and medium-tech manufacturing firm due to their operational complexities which are more prone to consequences of differences in departmental culture, use of language, priorities and measures of success as well as expectations of cooperation on a company-wide basis. We argue that these differences could potentially create invisible barriers to people's behaviour and their cooperation around common interest which may result in sacrificing corporate objectives for the attainment of functional goals. Hence, these findings have significant implications for such firms who perform under conditions of high uncertainty and require to effectively use teamwork that fosters knowledge sharing, organisational learning and innovation for their survival. It is, then, imperative for them to address cultural fits and tackle contradictions produced by local/functional optimisations and ensure a culture of open communication and cooperation, and continuous improvement is developed and maintained across the value chain (Rogers, 2001, Kaynak and Hartley, 2005).

Despite the cooperative behaviour prescribed by collective rationality, research has argued that it may incur the risk of loss of mutual gain by either of the co-operator (Cox et al., 1991). Therefore, it could be an interesting future research avenue to investigate the possibility of the resulting cooperative response by CFPVB to turn into opportunistic behaviours by the individuals involved and stimulate competitive attitude.

The above findings show the collective effects of BPO dimensions on both II factors, and, therefore, this warrants further research attention examining the impact of each individual BPO dimension on II, without the intervention of other related dimensions.

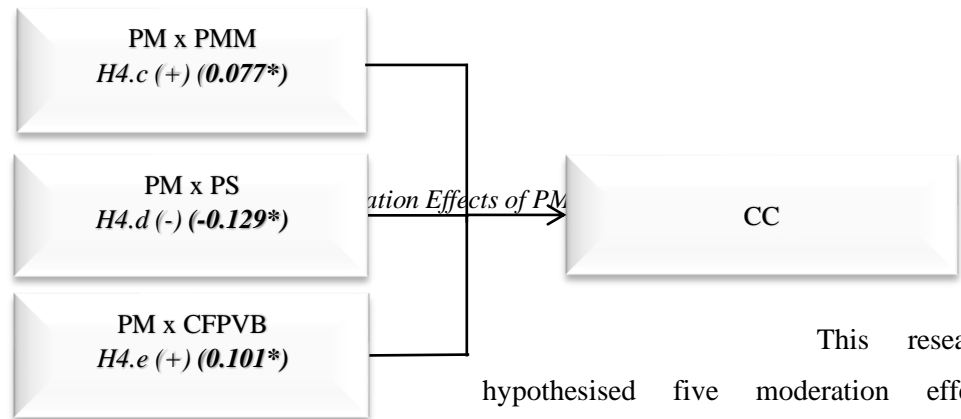
### **6.3. Discussion on the Moderation Effect of Product Modularity (PM) on the BPO-II Relationship**

This section seeks to discuss the research findings on the hypothesised relationships presented in Table 6.2. It provides a discussion on the significant moderation effects demonstrated in Figure 6.4, aiming to address the following research question:

**RQ3:** *“Does product modularity (PM) moderate the relationship between business process orientation (BPO) and internal integration (II)?”*

Table 6.2. Empirical Findings on Product Modularity (PM) Moderation Effect Hypotheses

<b>Product Modularity (PM) Moderation Effect</b>	<b>Hypothesis 4.a (H4.a -):</b> “The effect of process job (PJ) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Not supported
	<b>Hypothesis 4.b (H4.b -):</b> “The effect of process view (PV) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Not supported
	<b>Hypothesis 4.c (H4.c -):</b> “The effect of process management & measurement (PMM) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Partially supported in an opposite direction
	<b>Hypothesis 4.d (H4.d -):</b> “The effect of process structure (PS) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Partially supported
	<b>Hypothesis 4.e (H4.e -):</b> “The effect of customer-focused process values and beliefs (CFPVB) on internal integration (II) will be moderated by product architecture such as that this positive link is weaker for firms higher in product modularity (PM) than those lower in product modularity (PM).”	Partially supported in an opposite direction



This research hypothesised five moderation effects between the constructs under this study. The moderation effect of PM on the relationship between BPO and II received mixed, yet intriguing results. Interestingly, we found some evidence that in high- and medium-tech manufacturing firms, product modularity (PM) assumed a different role in that the construct either only partially moderates the BPO\_II relationship or not at all. The results revealed three significant moderation effects between the constructs, illustrated in Figure 6.4. This broadly agrees with the view in the literature that product architecture has a bearing on operational decisions pertaining to the value chain ties/structure. PM was found to have a negative moderation effect on the PS-CC relationship partially confirming its underlying hypothesis (H4.d). Additionally, the PMM-CC and CFPVB-CC were found to be moderated by PM in the opposite direction from that of predicted, thus H4.c and H4.e were not supported in the hypothetical direction. However, the present research is not unique in finding evidence against the effect of PM, as similar results have been obtained in the fields of new product development (NPD) and supply chain management (SCM). For example, in contrast with their predictions, Pero et al. (2010) reported that PM does not reduce the level of complexity in

supply chain configuration. They explained that given that modularity is a matter of degree contradictory results may be obtained in different industrial contexts. Alike, Caniato and Größler (2015) conducted a broad survey study and identified that product complexity, defined as a multi-item factor including product modularity, has no moderating effect on the relationship between NPD integration and firm's performance which contradicted their hypothesis. Furthermore, our results did not provide sufficient evidence in our dataset validating the effect of PM on the PJ-II and PV-II relationships in the population, thus their underlying hypotheses (*H4.a* and *H4.b*, respectively) were not supported. By and large, the findings could imply that high- and medium-tech manufacturing firms with higher level of PM are enabled, to some extent, to establish coordination capabilities to integrate business processes (Gomes and Dahab, 2010) when incorporating certain BPO elements. These results are also consistent with that of Huo et al. (2014) who demonstrated that product differentiation (which could be achieved through modularity) as a competitive strategy positively moderates the relationship between process integration and firm performance.

According to the value-transfer theory, supply chain literature argues that for the purpose of concentrating on their core competencies OEMs tend to transfer non-value adding activities to their suppliers who need to accommodate the relevant management and production responsibilities in their business (Doran, 2003, Doran, 2005). An empirical research on modular products by Lau et al. (2010b) has found that the development of a novel design is strongly associated with preserving the relevant architectural knowledge in house. Indeed, their findings suggest that the relationship between PM and II is contingent on the level of product innovation. This means to emphasise that a more tightly coordinated supply chain (SC) is required within a firm in order to share technical knowledge, overcome technical problems and specify design interfaces. As such, internal functions need to establish a higher coordination across their functional boundaries to co-develop new module/component and optimise product performance. As reported in the descriptive analysis in the current research, the majority of sample firms (>50%) were adopting the production strategy of '*the manufacture of familiar products*' which means that they may not be vastly involved in a new product development with their modular designs. Congruent with the above argument, this leads us to suggest that they are more likely to outsource their modular product to module suppliers and that could explain, in general, why this research did not find any significant effect from PM on II. The same logic could be applied to explain the mixed findings in relation to the BPO elements.

Besides, it is believed that the unique characteristics of the two concepts (i.e. modularity and BPO), could provide an explanation for this relationship. Indeed, those qualities of BPO overlapping with the fundamental aspects of modular product architecture including information structure and interdependencies among module interfaces (Sanchez and



Mahoney, 1996, Krishnan and Ulrich, 2001) may stimulate some interaction effects between the two concepts, thus potentially influence the BPO-II association. In adopting BPO, setting boundaries and classifying processes are critical steps which reflect the principles of modularity (McCormack and Rauseo, 2005). In developing a process view of an organisation at an enterprise level, McCormack and Rauseo (2005) have shown that the process of defining boundaries, process performance measures and interactions with customers is facilitated, using the principles of modularity. Modularity is built on the concept of decomposability, drawing system boundaries and simplifies system interdependencies. Therefore, while it lowers, to an extent, dependency across the development units allowing for less interactions outside the sub-system boundaries, our research results show that this is not always in conflict with the level of integration achieved by an organisation. In fact, at a component level modularity aimed at achieving division of labour and as a consequence the reduction of technological interdependencies may give rise to interdependencies of a different nature, given the likely constraints on actors' rationality and knowledge (Devetag and Zaninotto, 2001). These dependencies increase by increasing modularity, thus reinforcing the use of certain coordination mechanisms to align incentives and minimise cross-boundary conflicts. Therefore, in such situation, firms are likely to seek and achieve a desired degree of cross-functional integration to address differences in operating, structural and cultural characteristics of their sub-units (Ainamo, 2007).

These overlapping characteristics could also partially explain the insignificant moderation effects investigated in this research. Moreover, as previously discussed, under the main effect results, it was reported that the Parallel Model best explained the association between BPO and II. Based on that the simultaneous adoption of its elements could create overlapping characteristics which might offset the impact of one another. This claim is supported by looking at the Hierarchical Model in which, for instance, PJ became insignificant after the inclusion of PV in the model. However, this research did not attempt to investigate the overlapping premises among the constructs and is rather suggested to be considered for future research. On that account, the results discussion would solely be limited to those aspects of the literature investigated in this research which could provide a firm explanation for the empirical findings. The following sections present a detailed discussion on the significant moderation effects, followed by providing tentative explanations for the insignificant results.

### **6.3.1. The Moderation Effect of Product Modularity (PM) on the PMM-CC Relationship**

Although reported an opposing impact to that of predicted (*H4.c*), findings showed interesting results indicating that having a modular product architecture does not contradict with a process approach when it comes to process management & measurement (PMM). Yet,

no empirical evidence was found to support the existence of the same moderation effect when it comes to CTPO (the alignment of interests). As such, the results provided sufficient evidence which partially supports *H4.c* in the opposite direction. In broad terms, our findings suggest that II is not directly at the influence of a modular product architecture (no direct effect between PM and II). Markedly, this research reinforces the significance of PM which showed to play a complementary role in facilitating the evaluation and definition of process-based performance measures, and the assessment of team units output defined drawing on unique customer needs. In other words, counter to our expectation, not only the segmentation of deliverables for each autonomous entity/team is not in conflict with the objective of a process performance measure system, but also it expedites the adoption of PMM developed through BPO which enables a more efficient and effective cooperative communication (CC). In congruent with these findings, Worren et al. (2002) refer to Zenger and Hesterly (1997) and argue that in modular product development “self-managing teams are increasingly replacing hierarchy and considered separate ‘economic units’ that are configured to produce and exchange definable outputs, be measured as separated units, and rewarded directly for their performance”. Therefore, informed upon the significance of an organisation measurement system in driving employees and managers behaviour (Kaplan and Norton, 2001), this can explain that in firms where PMM is coupled with the product-oriented characteristics of a modular architecture (i.e. decoupling performance metrics) functions/individuals are more committed to process outcomes, and performance indicators are better communicated across the involved functions.

While, theoretical research on the implication of PM for coordination has widely argued that modularity removes the need for extensive II and leads to organisational disintegration due to task decomposition and the creation of relatively autonomous entities, the current research confirmed the positive effect of modularity on integration through interacting with a process approach of an organisation. In particular, these findings are in congruent with the body of knowledge suggesting the existence of a dynamic relationship between PM and II. It is generally agreed that modular product structure is used to cope with operational complexities in dynamic and complex systems through simplifying the management of interdependencies (Devetag and Zaninotto, 2001). One way to manage interdependencies is through defining standard measures and strict interfaces which allows high division of labour in production process, each with limited span of control focusing on their specialisation within their assigned modules (Hameri and Artto, 2002). This creates independence between modules and prescribes the integration of different modules. A high PM is associated with highly standardised performance indicators which allow the segmentation of process-specific performance indicators (Dörnhöfer et al., 2016) derived from process goals (Glavan, 2011). The results indicated that following the logics of a process-based approach, this segmentation

is performed in such a way that the combination of sub-performance indicators represents the overall performance of implemented processes. By breaking down these measures into smaller and more conceivable metrics, decision making across various functional units is optimised because information processing capabilities of individuals is enhanced. For this reason, they become motivated towards collective action supporting the accomplishment of team goals and objectives.

Drawing upon the results, PM and PMM seem to produce complementary effects. Neither PM nor PMM showed a direct effect on CC individually, while their interaction produced positive moderation effect promoting a higher CC. The results suggested further interesting insights on this interaction, indicating that the effect of PMM on CC changes depending on the value of PM (see Figure 5.19 towards the end of Chapter Five). Thereby, a twofold role of PM was revealed in affecting the relationship between PMM and CC. In one hand, it emerges that in the absence of PM (low modularity) PMM seems to have no impact on CC, similar to the insignificant direct effect. On the other hand, the existence of a high PM results in a positive and significant association between PMM and CC. Indeed, informed upon this complementary effect when PM is low their interaction has no impact on cooperative communication, whereas high PMM results in higher CC when PM is also high. This contends that the effect of PMM on CC aspect of II is contingent on the level of PM within the context of high- and medium-tech manufacturing firms, confirming their interaction effects on II. Therefore, these companies can use a modular product architecture to better serve PMM aspect of BPO for the purpose of promoting cooperation. These findings are also in line with our earlier argument about the multifaceted and complex nature of PMM which should be aligned with organisational strategy and suit the nature of the jobs performed. They further suggest that given its process focus PMM provides measures in relatively aggregate level which may be too abstract to be conceived by decision makers, particularly in the presence of operational complexities. Under such circumstance, they may lack to solely maintain the interrelationships between decisions made in a distributed manner (due to the existence of high process structure) as the overall outcome supporting strategic decision is obtained by combining performance-relevant data of several business processes and individual information on the contribution of process actors may be lost.

These results open a different but relevant line of argumentation in regard to what is emphasised as organisational complementary capabilities and resources in order to reap the benefits of PM. However, the investigation of such resources and capabilities is beyond the scope of this research and is suggested for future research (Garud and Kumaraswamy, 1995, Cusumano et al., 1998, Worren et al., 2002). Similarly, they could provide some implications for a separate research stream which calls for proposing ways/methods to improve cross-team communication in modular product development (Sosa et al., 2003, Parraguez et al., 2016).

For instance, Sosa et al. (2003) suggest that the assessment and management of design interfaces at an aggregate level helps facilitate managing cross-team technical interactions. Parraguez et al. (2016) also argue that interface management in process domain is essential for coordinating activities and information, particularly in large and complex systems. The role of interface management becomes undeniably vital in large project systems in which there is a “rapid growth of potential and actual interactions” leading to an increased complexity (p.160). As such, a management system measuring and managing the system characteristics, parts interfaces and interdependencies needs to be in place, ensuring an effective participation of planning, concept development and system level design experts (Mikkola, 2005), for the modular system to work as a whole. In a similar vein, it is argued that modular product needs to be incorporated with an extensive management of product performance and specifications in order to manage the complexity involved in the interrelationship between several functions and their knowledge association within the product development process (Brusoni, 2005, Pandremenos et al., 2009, Kubota et al., 2013). As such tasks structure becomes clearer, the involved teams and functions follow an integrated criteria and reward system, creating an infrastructure for rapid knowledge transfer within a company.

### **6.3.2. The Moderation Effect of Product Modularity (PM) on the PS-CC Relationship**

The statistical analyses demonstrated that a modular product architecture has a negative moderation effect on the PS-CC relationship. This indicates that when the moderating effect of product modularity (PM) is accounted for, the positive relationship between PS and CC is weakened. In general, our findings reinforce the significant consequence of a modular product architecture for the value-chain structure, including the pattern of works arrangement and relationships. In support of these findings, literature has extensively argued that PM could become an invisible barrier to a cross-functional flow of communication and interaction, and the strength of its impact lies in the degree of standardised interfaces which create embedded coordination and allow for the formation of independent and relatively autonomous team structure (Pil and Cohen, 2006, Vickery et al., 2016). In particular, empirical research has shown that companies operating in highly complex manufacturing environments are more likely to be influenced by the so called loosely coupled SC resulted from PM (Vickery et al., 2016). While these findings confirm the general state of the current literature on the consequences of PM, they refute previous arguments which criticise a perfect mapping between product architecture and teams interaction (e.g. Terwiesch et al., 2002, Mihm et al., 2003, Sosa et al., 2004). As for the relational aspect of integration, this research did not find sufficient evidence supporting the negative moderation effect of PM on the PS-CTPO

relationship. On that basis, the underlying theoretical assumption (*H4.d*) was only partially supported. Therefore, the results need to be interpreted with caution.

One of the remarkable features of a modular architecture is to provide a set of rules to control interdependence among components/modules with the aim of reducing reciprocal influence of module interfaces and coping with product complexity. Interdependence occurs when functions/teams/individuals depend on each other for knowledge/information, materials or resources to perform their tasks (Ro et al., 2007). Minimising these interdependencies at a firm level results in division of labour (i.e. tasks separation) where the control is left to specialised units for decision making responsibilities (Devetag and Zaninotto, 2001). In such a view of modularity as an architectural strategy to manage product complexity, our results point to the likelihood that the positive effect of PS on II is contingent, to an extent, on the level of PM. Our findings appear to be well-substantiated by the growing body of research in the context of the mirroring hypothesis (e.g. Colfer, 2007, MacCormack et al., 2012, Colfer and Baldwin, 2016, Sorkun and Furlan, 2017) which argue that an organisational structure should support its product architecture which was initially theorised by Sanchez and Mahoney (1996). Empirical observations have also advocated this view under the condition of product architecture complexity and revealed that “in technologically dynamic industries, [as in the current research], where knowledge boundaries [go beyond] operational boundaries” (Colfer and Baldwin, 2016, p.709), firms tend to align organisational structure with product architecture.

It is noted that a product conceptual and technical structure is reflected in a firm's problem-solving structure (Clark (1987). The understanding of these technical structure is important in order to manage product development projects involving the product architecture definition and determine the development teams (Pimmler and Eppinger, 1994). This enables to anticipate technical communication linkages concerning the project implementation, allowing to plan for certain aspects of organisation design (Chang and Ward, 1995). However, the identification of task related interactions is not always easy particularly in complex product development. Under such circumstances, research has demonstrated that identifying and managing unpredicted interfaces and coordinate individuals and teams interdependence are challenging tasks specially when product architecture maps onto the organisational structure (Sosa et al., 2003, Sosa et al., 2004, Sosa, 2007). Hence, our findings lend support to previous results and offer compelling evidence that high modularity at a product level creates a form of misalignment in an organisation which follows the logic of a process-based structure. This observation further extends our knowledge on the implications of product architecture for business processes, suggesting that the resulting misalignment may hamper the effective cooperative activities across the border of an organisation. For example, in a situation where components share unpredicted interfaces and design teams have failed to estimate potential

communication pattern, cross-boundaries coordination required to address technical/structural changes is likely to be dismissed. This may hence decrease the overall performance of a modular system “due to a lack of tuning in the remaining components to adjust for this change” (Devetag and Zaninotto, 2001, p.8). Therefore, these results provide additional support for the earlier findings on the main effect of PS on II and are also consistent with the extant literature arguing that organisational structure is a potential barrier to II.

An important contribution of our empirical result is that it provides insights to managers who deal with cross-boundary interdependencies and coordination. As such, it can help inform them to acquire an in-depth understanding of the correspondence between product architecture and organisational design within the context of integration. Particularly, in adopting modular architecture at a product level they are encouraged to account for undocumented interfaces and be prepared and plan for establishing effective cross-team interactions as required.

### **6.3.3. The Moderation Effect of Product Modularity (PM) on the CFPVB-CC Relationship**

In contrast with the hypothesised assumption (*H4.e*), the statistical results revealed that PM reinforces the positive relationship between CFPVB and CC. However, the results showed that the CFPVB-CTPO relationship is not moderated by PM, suggesting that PM is not always a sufficient condition to affect their association. The analyses demonstrated that when the moderating effect of PM is accounted for, there is a significant impact on CC of the interaction between PM and CFPVB. This suggests that the positive effect of CFPVB on CC increases with the rising level of modularisation. These findings refute previous research which suggest that high modularity may lead to cultural discrepancy and conflict formed among social actors who are assigned to different sub-teams due to their cross-boundary knowledge incompatibilities (Afzalur Rahim, 2002). Despite this, findings can uncover informative insights into alternative implications of modular product for organisational management structure.

An interesting observation of the results is that customer-focused culture is more effective under certain product architecture. More precisely, firms pursuing high product modularity achieve more integration benefit from CFPVB than firms pursuing a lower degree of modularity. Our results could potentially suggest certain similarities between a customer-focused organisational culture and the values developed through architectural decomposition given their positive interaction effect. It is a common approach that each module serves multiple internal customers who have different goals and interests. This indicates that a module architecture could interact with a number of other modules/components. Therefore, the prominent role of customer needs in defining the organisational values is not undermined

in a modular product development, since understanding of hierarchical structure by selected teams is crucial in platform architectures which provides the basis to prioritise customer needs, translate them into system-level performance and eventually cascade them down into sub-system/sub-module requirements (Calabretta et al., 2008).

Furthermore, research has indicated that in developing modular architecture specialised teams dedicated to design specific module/component are likely to develop intra-team/within-boundary shared language and identity (Tushman and Katz, 1980, Ulrich, 1995). Empirical evidence suggested that the creation of sub-cultures coexisted with a corporate culture which is often found in innovative industries does not imply a cultural misalignment (Calabretta et al., 2008). Therefore, while individuals belonging to sub-groups/or units are identified by the cultural identity of the team of which they are members, the generation of these sub-cultures does not give rise to a departure from the corporate culture (Thøger Christensen et al., 2008). This coexistence which is described as cultural plurality is managed in such a way that contributes to customer needs as a whole. Similarly, literature suggests that for the whole modular system to work, certain design teams need to collaborate to address critical design interdependencies and overcome knowledge asymmetry and ambiguity (Ancona and Caldwell, 1992, Sosa et al., 2002, Cummings, 2004, Sosa et al., 2004).

Another possible explanation of these findings could be associated with the mechanisms employed to coordinate divisions of labour in modular product development. The importance of using modularity at product level becomes increasingly salient in firms aiming to accommodate the development of autonomous modules by independent design units (Sanchez, 1995, Sanchez and Mahoney, 1996). In conjunction with our empirical findings on the impact of PM on process structure scholars have also advocated that the design of a modular system is mirrored in organisational structure. As such, it was argued that product design practices per se do not provide sufficient mechanisms to coordinate design interfaces, particularly, in a complex environment which is more likely to experience evolving interdependencies and iterative product development (Sosa et al., 2004). In order to address these coordination needs, research has indicated activities coordination could be achieved by the use of some organisational coordination mechanisms such as cultural arrangements (Paashuis and Boer, 1997). For example, job rotation strategy may be used in which employees are asked to take on new tasks to learn multiple working styles and culture within each team. In fact, this is essentially valued in a modular product development organisation who relies on cross-functional nature of teams to assess the functionality and feasibility of architectural design, using their expertise and knowledge. As a result, the value of CFPVB can be more easily attained by teams/functions involved in the value-adding activities. Therefore, teams can further rely on mutual adjustment which encourages collaboration.

In general terms, the development of modular product may not bring universal benefits for manufacturers. Our findings emphasise the importance of modularity for managers seeking to bring together disparate entities in order to build integrative capabilities. They may thus raise awareness regarding potentially cultural implications of product architecture. While, modularity does not appear to help manufacturers who aim to improve the relational capital among employees, firms with a customer-focused cultural strategy may achieve better structural social capital under the condition of high modularity. Therefore, they can focus on design decisions critical for the cultural aspect of their organisation and identify those architectural characteristics that have the most impact on driving cooperation and breaking the silos across boundaries.

#### **6.3.4. Tentative Explanation of the Insignificant Moderation Effects**

The research findings indicated that PJ-II is not moderated by PM, thus the results did not provide sufficient evidence to support *H4.a*. Therefore, this research suggests that PM does not seem to interfere with the implications of PJ for II in high- and medium-tech manufacturing firms. In addition, the findings did not provide empirical evidence suggesting that modular product architecture is a contingency factor influencing the relationship between PV and II. In other words, organisations exercised PV did not attain a lower level of II in the presence of PM. On that account, hypothesis *H4.b* was not supported. Furthermore, the positive results pertaining to *H4.c* and *H4.e* indicated that PM does not seem to constrain the positive association between PMM, CFPVB and II, while only partially reinforced these relationships. Whereas, its negative implications for the PS-II relationship, although partially, was empirically supported. Therefore, informed upon the findings as the level of modularity varies the strength of the relationships between PMM, PS, CFPVB and CTPO remain constant. These findings make it imperative to enhance our understanding of important contextual factors which may have led to such conclusions by providing some tentative arguments.

Earlier we briefly discussed that firms strategic approach to product design may have had some implications for the research findings. That is, firms adopting a modular product design may essentially outsource part of their operations and activities involving the design, R&D, manufacturing, etc. Research has argued that a firm sourcing strategy is a function of its product architecture features (Salvador et al., 2002). For example, the level of product modularity determines suppliers' proximity in terms of culture, managerial and ownership structures, and geographical location (Fine, 1998, Caridi et al., 2012). Following this logic, supply chain (SC) partners delivering products with high modular architecture tend to be located in far distance from their contract manufacturer due to high level of standardisation and are only linked loosely for products co-design. Additionally, the business culture of the



network partners is not similar allowing for scaling down extensive cooperation and information sharing (Fine, 1998). Empirical evidence has also indicated that the level of innovativeness could further explain differences in adopted strategies (Lau et al. 2010b). For instance, the results obtained from Caridi et al. (2012) revealed that firms launching less innovative products are more likely to outsource their production. Whereas, firms involved in breakthrough products tend to keep their operations in-house and adopt collaborative activities across their involved functions (Christopher, 2005, Lau et al., 2010b). Therefore, given that the majority of our participants characterised their products as derivative, these results are not particularly surprising.

Moreover, having obtained a heterogeneous sample of both OEMs and suppliers, it is acknowledged that our findings are grounded on the basis of their combined opinions and may vary depending on their specific modularity strategy. For example, in a case study by Pero et al. (2010), it was found that from an OEM's perspective a modular product architecture does not lead to an increased complexity in SC configuration due to their low level of involvement in the management of module suppliers network. However, they discovered an opposite opinion held by suppliers suggesting that highly modular products could lead to an increased SC configuration. These results indicate that firms strategic position in the SC and their approach to product development are determinant when it comes to PM implications, thus could be substantially influential to an extent that alter the research findings. Likewise, Blackhurst et al. (2005) argue that the use of certain SC practices (e.g. SC structure, outsourcing strategy, etc.) could determine the extent to which SC is affected by product design decisions. To sharpen our understanding in this regard this proposition needs a more investigative work in which the effect of these aspects could be isolated on the proposed relationships. Future research could further broaden this approach by incorporating both inter- and intra-firm aspects of modularity and its moderation effect on the BPO-II relationship.

By tapping into the multiple stages involved in modular product development process further explanations could be drawn to shed more light on the lack of significant moderation effects. Literature argues that the information structure created through modular product architectures is not fully embedded at the outset of the development stage and requires recurrent tasks implementation to mature (Henderson and Clark, 1990). It involves a gradual procedure to become embedded whereby a clear picture of tasks and goals is reached, and a dominant product design is emerged (Henderson and Clark, 1990). In addition, the most critical aspects of the information structure are affected by the decision made in the early stage of architectural development (Ulrich, 1995). Similarly, Danese and Filippini (2010) note that during the early phases firms tend to discuss and resolve conflicts and disagreements which are likely to develop between functions at later stages. Thus, it is expected to have the most significant impact at the outset of the development process. Firms with a dominant product

design have passed the early stage, experiencing a more streamlined flow of activities. This represents a potential research avenue calling for more investigation which enables further explanations on the extent of this argument.

The empirical findings stress the potential benefit of CFPVB and recognise that it could act as a compensation mechanism aligning teams/functions culture. Some product modularity literature advocate that high PM may confine the willingness to cooperate (e.g. Staudenmayer et al., 2005, Gomes and Dahab, 2010), creating a natural tendency in teams to emphasise on intra-team goals development and sub-optimisation. While these could create cultural conflicts, values and beliefs driving the cultural attributes of a firm are embedded in individuals interaction which are not prone to changes readily (Lyles and Schwenk, 1992) and act as “the social glue holding an organisation together” (Tsai, 2011, p.2). In addition, a study conducted by Killen and Kjaer (2012) has demonstrated that a culture allowing to maintain communication between projects enhances the understanding of projects linkages. “Perceived [...] interdependence may set the stage for constructive and open-minded exchange of task-relevant information...” (Van der Vegt et al., 2001, De Dreu, 2007, p.630). As such, in firms with strong customer-oriented culture the shared values and beliefs are held between individuals unconsciously (Schein, 1990). The development of a customer-oriented culture provides a form of adaptability and responsiveness to change (Ryals and Knox, 2001). We discussed that these qualities also underline modular product development projects for which firms are compelled to obtain essential knowledge in order to develop a set of modules and address various customers’ needs (Shamsuzzoha, 2011, Killen and Kjaer, 2012). The need for understanding cultural aspects of the projects becomes imperative in complex environments due to large number of people and physical components involvement in development process. This is a serious criticism to both theoretical and empirical research who tend to focus on achieving the benefits of loosely coupled supply chain (SC) resulted from PM. That is, the complexity involved in these environments heightens the need for the culture of information sharing promoting cooperation and collaboration among project teams while a level of adaptability is maintained (Aritua et al., 2009, Jonas, 2010, Killen and Kjaer, 2012). Thus, although high PM may be recognised as a potential factor creating silos, a strong customer-oriented values and beliefs driving the cultural attributes of an organisation may compensate for this effect. This, however, deserves to be further investigated in future research.

## **6.4. Summary of the Chapter**

In this chapter a detailed discussion of the key findings associated with the research theoretical hypotheses was presented. The chapter focused on answering the three main

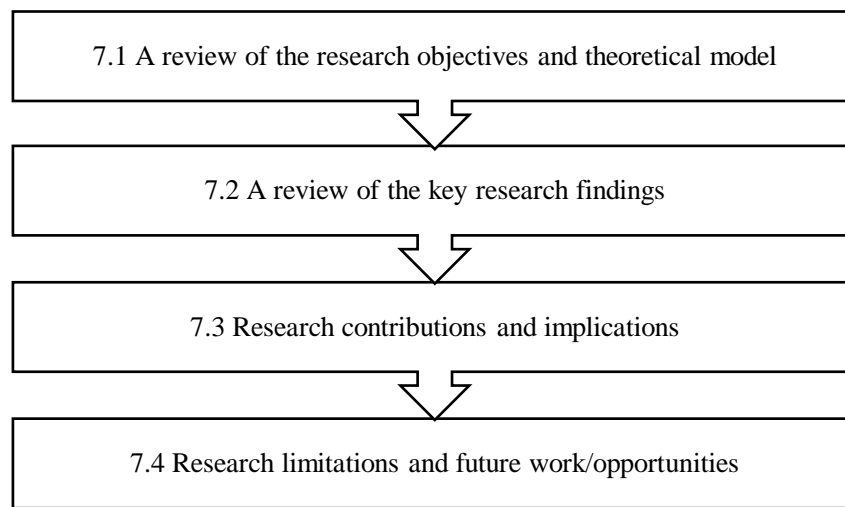
research questions identified in Chapter Two: “*What is the relationship between business process orientation (BPO) and internal integration (II)?*”, “*To what extent taking a process-oriented approach could provide a dynamic basis underlying internal integration (II)?*”, “*Does product modularity (PM) moderate the relationship between business process orientation (BPO) and internal integration (II)?*”. The research theoretical framework proposed based on the literature review was first modified drawing upon the empirical findings. This was followed by providing an extensive discussion on the direct and moderating effects between the three key concepts of BPO, II and PM within the context of high-and medium-tech manufacturing firms.

The following chapter concludes the research and the key theoretical contributions to the extant research in SCM, OM and BPM are underlined. It further identifies implications for practice and limitations of the research are addressed as implicit opportunities for future research.

## Chapter Seven: Conclusion

### 7. Introduction

This concluding chapter aims at consolidating the key findings in relation to the main objectives of the research, thereby discussing the main theoretical contributions. It then follows to summarise the link between the findings and the research hypotheses. Additionally, it draws on managerial implications concerning the use of BPO and PM for achieving II. In order to inform future research in SCM and OM, it also reflects on the research limitations, proposing potential avenues of investigation. Figure 7.1 illustrates a summary of the chapter structure.



*Figure 7.1. Summary of Chapter Seven*

#### 7.1.A Review of the Research Objectives and Theoretical Model

The key objective of this research lied in investigating the concept of internal integration (II) in the context of supply chain management (SCM), particularly focusing on developing and testing a theoretical model which provides a dynamic basis to nurture intra-firm integration. As such, it sought to propose a new theoretical understanding of the concept of II through adopting a process-oriented approach. In addition, it aimed to explore the effect of product architecture on organisational ties and cross-boundary communication structure. It, then, endeavoured to cast light on how a modular product architecture influences this model, given that II and product modularity (PM) have become intertwined as two significant internal resources commonly developed in manufacturing firms and the importance of modularity in studying organisational design. In particular, it investigated whether the adoption of high PM creates a form of misalignment between process approach and cross-boundary relationships. In order to achieve these objectives, three key research questions were proposed:

**RQ1:** *“What is the relationship between business process orientation (BPO) and internal integration (II)?”*

**RQ2:** *“To what extent taking a process-oriented approach could provide a dynamic basis underlying internal integration (II)?”*

**RQ3:** *“Does product modularity (PM) moderate the relationship between business process orientation (BPO) and internal integration (II)?”*

In seeking to answer the three research questions a deductive critical realist approach was taken to account for the context-specific characteristic of the concepts under investigation. It supported the central focus of this research being the human-related properties forming one of the principal aspects of a supply chain (SC) system, providing a logical basis to examine the proposed causal relationships. Thereby, some degree of flexibility was provided to draw causal conclusions, helping to explain the empirical findings. A survey questionnaire instrument was employed for a quantitative examination of the relationships informed by the literature. Prior to the explanatory survey administration, a pilot study was also conducted to refine the questionnaire, improve the structure and wording, and thus ensuring the validity of data collection instrument. Using inputs from the extant literature, together with the insights from the survey, data was collected from OEMs and suppliers in five high- and medium-tech manufacturing sectors in the UK. The data was subsequently used to conduct multiple statistical analyses in order to provide descriptive account of the participating companies, identify the underlying dimensions of internal integration (II) and test/verify the research theoretical model.

Although internal integration (II) has been extensively studied within the context of supply chain management (SCM) in the past few years, most studies have focused on the performance benefits of integration. As such, attempts for its theorisation have remained limited particularly to its technological aspects compared to other forms of integration, including suppliers and customer integration. A key neglected area in this field is the role of business processes in developing integration on a company-wide basis. Most of the literature so far has focused on technology and business performance implications of a process approach (e.g. Frei et al., 1999, McCormack and Johnson, 2001, Trkman et al., 2007, Movahedi et al., 2016). At the same time, theoretical and empirical research within the context of supply chain management (SCM) has provided evidence that business process orientation (BPO) helps companies to develop coordination capabilities with the means of certain managerial practices (e.g. Hammer, 2001, Aparecida et al., 2012, Pradabwong et al., 2015, Pradabwong et al., 2017). In fact, it renders a management strategy to integrate value-adding activities, leading firms to depart from viewing their business as an aggregate of distinct functions and appreciate the strategic importance of processes spanning these functions (McAdam and McCormack, 2001).

Besides, literature drew our attention to the strategic importance of product architecture and argued that it is a critical part of this strategy and its characteristics have a bearing on operational decisions concerning multiple functions. In this sense, modularity as a product design property was argued to alter the structure of communication and the need/tendency for cooperative activities (Mikkola, 2007) due to high standardisation and division of labour (Colfer, 2007). On the basis of empirical evidence, the magnitude of these consequences were, particularly, deemed to be extreme in complex and dynamic environments where complexity represents a key challenge in identifying and addressing the degree of interdependence across the SC (Vickery et al., 2016). Nevertheless, there was no clear evidence suggesting the dynamics of modular product architecture and SC ties. Therefore, this research addressed this gap by exploring whether the adoption of BPO coupled with high modularity may become a barrier to effective communication and distort integration decisions of a firm.

This research integrated insights from literature streams on operations management (OM), supply chain management (SCM), business process management (BPM) and new product development (NPD). The research theoretical framework was mainly driven by the understanding that BPO involves a developmental life cycle through which processes are defined, managed, measured and continuously controlled in order to achieve an integrated SC. The theoretical model was developed drawing on the logics of contingency theory (CT) and the competing model approach in order to explore the effect of process approach and product architecture on II conceptualisation. Informed upon the literature it was argued that the implication of BPO for II is contingent on alternative developments of its dimensions. As such three competing models were proposed, including the Parallel, Mediation and Hierarchical Models. It was also discussed that modularity could be observed implicitly as a potential constraint that creates different forms of architectures such as product, process and knowledge and may determine how the interrelationships between BPO and II manifests. Thus, according to what the contingency approach postulates, we argued that II should fit its business processes that determine the organisational structure which is also contingent on a firm level of PM (i.e. product architecture characteristics).

As part of our statistical tests we conducted factors analysis in exploring what constitutes the underlying scope of II. Consistent with the literature, we identified that II is a multidimensional construct comprising two factors of *cooperative task planning orientation (CTPO)* and *cooperative communication (CC)*. In an attempt to answer the first and second research questions the three competing models were examined and a comparative assessment was performed using multivariate analyses. This examination was intended to identify what composition of BPO elements best explains the relationship between BPO and II. The five dimensions of BPO adopted from the literature and used in developing the research competing

models were process job (PJ), process view (PV), process management & measurement (PMM), process structure (PS), and customer-focused process values and beliefs (CFPVB). In keeping with our predictions, the results of our study mounted on the importance of BPO in nurturing II. Evidence presented suggested that the combined effect of BPO elements developed in parallel yields the highest magnitude of impact on II, confirming the predictive accuracy of the Parallel Model over the other two models. These findings are broadly in line with the view of our predecessors such as Jeston and Nelis (2014) and Al-Mashari and Zairi (1999) who argue that process approach is not an evolutionary event, but requires a gradual and parallel institution of its elements with the participation of people involved to deal with the complexity of its development process. Our model provides a first step towards suggesting the factors that serve the underlying basis of intra-firm integration. These factors and their associations with II further our understanding of how managers can enable the development of integration across the key business processes.

The outcome of these analyses informed the investigation of the third research question concerning the moderation effect of PM on the link between BPO and II. PM was measured as a one-factor construct using the measures developed and validated in the literature. The findings of this stage showed mixed and interesting results, reflecting the multifaceted implications of PM for this relationship. It was found that increasing modularity and the potential unpredictable interdependence across units boundary in complex manufacturing environments heighten the need to establish coordination mechanisms and governance arrangements that address possible operating, structural and cultural differences. At first sight we predicted that the adoption of high PM could become a barrier for a process-oriented organisation. However, the results showed that BPO and PM could co-exist while maintaining a certain level of cross-functional cooperation. Three significant moderation effects were detected, yet only one supported its underlying hypothesis and the other two relationships were found to be significant in the opposite direction. On that basis, we contended that the presence of high modularity may contribute to the effectiveness of BPO on communication structure.

### **7.2.A Review of the Key Research Findings**

The concept of process orientation is a key building block in an organisation with a focus on designing, implementing and executing key business processes in a horizontal structure and brings people together with shared organisational objectives. Through BPO the span of control can encompass the entire company which allows organisations to provide mutual access to resources in such a way that supports customers' needs, "thus ensuring communication and the coordination of [employees] efforts in a way that virtually eliminates

hierarchy [...]” (Salkić and Bošnjović, 2013, p.41). In general, the empirical findings provided both partial and full supports for the proposed relationships, and the research framework was modified accordingly. On the basis of the insights gained from the empirical results this research concluded that it is possible to achieve high II through taking a process approach. In fact, the results presented significant insights into the BPO-II relationship, suggesting that BPO may be adopted as a way to organise and improve internal cooperative orientation and communication across functional entities/teams involved in the value-creating activities. In doing so, it helps break down functional silos that is a common approach in many companies, particularly in high- and medium-tech manufacturing firms which are more prone to the negative consequences of poor integration. Thus, BPO could serve the development of integration at an intra-firm level. These findings were reasonably consistent with those identified by previous research which studies the aspects of organisational connectedness and cross-functional conflicts (McCormack and Johnson, 2000), while also furthered the conception of BPO implications within organisations. The key research findings are presented in the following and their theoretical contributions are briefly discussed.

**PJ-II:** Previously, we elaborated on the managerial skills and resources constraints of SMEs accounting for 85% of our sample size and argued that given this significant number the results suggested that certain process management practices may not be implemented or considered as key factors in the decision process. Although, the evidence indicated that some BPO dimensions (e.g. process job (PJ)) do not have individual effect on II, it may still be the case that they are enablers in a way that they provide the ground for other BPO dimensions. While much of the literature suggested the strategic importance of top management commitments (i.e. PJ), our results suggested otherwise. Our plausible explanation for the lack of significant effect could be that the management commitment in promoting process approach, albeit present, may serve for something other than promoting internal integration (II). For example, Kohlbacher and Reijers (2013) suggested that a process owner who has the power to initiate process changes and defined process performance measures plays a significant role in the application of continuous improvement methods rather than directly enhances process performance. This was discussed in detail in the previous chapter in relation to the dynamic relationship between process job (PJ) and process management & measurement (PMM) dimensions. It is also conceivable that the association between some BPO dimensions and II factors may be contingent upon some variables that are not examined in the current research. An example of this contingency effect was also evident in our empirical results in which we found that the effect of PMM on cooperative communication (CC) became significant and stronger in the presence of high modularity because information processing capability of decision makers is optimised.



**PV-II:** The process view (PV) dimension of BPO was emerged as a fundamental factor accounting for the third largest overall magnitude of impact on II. In accordance with our theoretical framework and consistent with the existing research (McAdam and McCormack, 2001, Lockamy III and McCormack, 2004) our results indicated that end-to-end and cross-functional process modelling documentation and roles definition may help craft contexts that promote a sense of community and stimulate cooperative actions by influencing their group-interested behaviour and the level of their collective efficacy. The implication of this is that improved transparency in defining and documenting processes is of high importance for the provision of an overview of their value contribution to customers, particularly in dynamic and complex business environments. In fact, the high level of uncertainty and instability which are inherent in these situations (Troy et al., 2008) yield an increased environmental dynamics, thus putting them in a greater need for leveraging cross-functional knowledge and expertise. They may, then, need to achieve a high level of transparency in how different processes are interrelated through defining key business processes which should be executed by managers. Equally important is a clear definition of roles/responsibilities and their interfaces in relation to processes which allows the individuals elevated perception of process-oriented goals and objectives and stimulates participative decision making. This could provide an explanation as to why failure rates in achieving II is still high in practice. These findings contributed to the theory by shedding light on the significance function of PV in the effectiveness of BPO and also highlighting to what capacity it influences integrative decisions on a company-wide basis. These results enlighten SCM literature about the prevalent role of management commitment to communicating a PV for II. One of the challenges facing managers is to change their business mentality in the pursuit of viewing organisations as a combination of highly integrated processes. Under such approach, at a strategic level they need to be willing to act as a mediator to influence functionally-based behaviours in regards to roles and responsibility and ensure their function is aligned with and integrated in processes. At an operational level, they also need to ensure that the need of different stakeholders is broaden to include both internal as well as external groups and individuals and operationalised in employees role definition. This could eventually contribute to their strategy implementation and organisation' future success through fulfilling their requirements.

**PMM-II:** The research concluded that with the main purpose of aligning process measures with the ultimate business objectives, PMM enhances II through impacting the relational aspect of integration. Although, the significance of a well-designed performance measurement and reward system is clearly stated in the current literature as one of the levers for integration (Pagell, 2004), PMM revealed the smallest overall magnitude of impact among all other factors on II. With this significant relationship limited to CTPO enhancement, this

research contributed to the theory by shedding light on the multifaceted and complex nature of PMM and concluded that the sole implementation of its principles does not necessarily provide the means to promote cooperative communication. Likewise, it further reinforced the importance of appropriate performance measurement system in order to advance integration in congruence with the past research (e.g. Glavan and Vukšić, 2017). In particular, the need to develop such systems in high- and medium-tech manufacturing firms is contended. In these environments efforts and contributions are considerably recognised through performance measures upon which individuals are awarded. Therefore, this research provides support for the existing literature which suggests the negative effect of poor performance management system on cross-functional integration (Tang et al., 2013). Furthermore, this would appear to raise important managerial implications suggesting that among the process-oriented activities and steps that the management can take process performance measurement may be used and imbedded in the organisations to help improve the alignment of decision makings across organisational functions. At the same time, building a comprehensive and boundary-spanning performance management and measurement system helps managers (from across different functions) disclose areas of mal-performance and proactively take corrective actions using its measures. It further increases the transparency in regard to the function's value contribution and sets the stage to achieve mutual performance improvement through fostering cooperative mindset. Given that the dominant participating firms were SEMs, these findings also contributed to the theory by suggesting that smaller firms are more likely to suffer from the lack of resources assigned for integrative practices possibly due to the fact that they do not apply them to the same extent as the larger firms, so their "applicability and feasibility in [smaller] firms are yet to be determined" (Koufteros et al., 2007, p.848). Conclusively, the role of PMM on II according to firms size, which was beyond the scope of this research, deserves further investigation in order to identify the applicability of a measurement mechanism for promoting integration in such firms.

**PS-II:** The findings suggested that process structure (PS) has the largest overall magnitude of impact on integration among all the other BPO dimensions, emphasising its foundational role. As such, this research concluded that success in effective II is dependent to a large extent on an organisational structure. We provided strong evidence for its enabling role to achieve an elevated level of both relational and behavioural integration. Thus, the degree of orientation to process structure is a critical aspect determining coordination of activities and resources across the value creating activities, while building an infrastructure that supports cooperative mind-set and communication (Ladeira et al., 2016). These findings make valuable theoretical contribution to an ongoing debate in the management literature about the active role of organisational structure on building intra-firm relationships (e.g. Holtzhausen, 2002, Pagell, 2004). In particular, our framework goes beyond the existing research that focus on

structure as a constraint for integration and depicts the relationship between PS and II. Our findings imply that the values of process structure, e.g. customer orientation, teamwork, multi-dimensional and cross-functional authority, significantly contribute to an effective execution of company-wide integration. Although, there has been a growing recognition among academics that grouping/structuring people around their functional expertise is detrimental to collaborative communication, and the ability to respond to change which may arise due to the lack of customer-focused structure (e.g. Hammer and Champy, 1993, Stanton and Hammer, 1995, McCormack et al., 2003), companies still continue to use a functionally oriented mode of work arrangement and management (Braganza and Korac-Kakabadse, 2000). The consequences of poor communication and the lack of easy access to cross-functional knowledge and expertise are particularly manifested at a larger scale in complex and dynamic manufacturing environments who experience the severity of their impact to a greater extent due to their operational complexities and the span of employees' job involvement. Therefore, the research observations may suggest several courses of action concerning organisational structure. For example, managers at all levels of organisation may use processes as a unit of analysis for decision making and resource allocation to operations. As well as their sole responsibilities for their individual activities, this requires their joint commitment to take on accountabilities for resources optimisation and utilisation being prioritised not only within their functions but also at process level at which they operate. Such initiatives produce cross-boundary interaction, creating an environment for a better coordination of people across the organisation. In line with the literature it was also argued that PS and functional structure may co-exist to address specialisation needs in such firms dealing with multiple products/markets and technology requirements. However, this statement needs further investigations.

**CFPVB-II:** Positioned as the second most important factor CFPVB was identified as a strong organisational culture which supports the dynamic nature of II and leads to practices consistent with cooperative behaviour and relations. In other words, this research concluded that a process-based culture and its underlying values represents a social structure that seems to engender behaviours and actions supportive of integration needs and objectives, such as collective mind-set, collaborative participation and decision making, etc. These findings tie in with the growing body of literature that identified social capital as a critical success factor in the BPO adoption (Llewellyn and Armistead, 2000, Kujansivu and Lönnqvist, 2008). In addition, our research draws attention to the formation of such social values in helping develop collaborative relationships among people with different and sometimes conflicting goals and objectives through aligning cultural diversity. Our study particularly addresses the most neglected theoretical debate about culture relation to process management practices, supporting the dependent aspect of culture in the BPO adoption (Schmiedel et al., 2019). Within the context of integration our findings on the supremacy of the proposed competing

models suggested that viewing culture as a dependent variable which has an active role and not a mere context factor (independent aspect) may be most effective for high II. We interpreted this by tapping into the practical complexity of BPO execution which requires a culture that is associated with process-friendly values and beliefs in order to directly contribute to cooperative behaviours and communication. Furthermore, our study can serve as a specific example for practice which encourages practitioners to consider cultural aspect of BPO as a manageable parameter in organisations. In part, our framework could further their understanding into CFPVB shaped through process management practices to stimulate behaviours that support II. At the same time, this study cautions against the use of this view as a universal remedy to help increase integration performance. While the value of customer orientation is fundamental to any business process considering every process has both an internal and external customer, a contingency view should be taken in relation to the role of culture in this context to address performance issues in BPO and explain changes in social norms and how their respective effects enable or inhibit integrative practices.

***The Moderation Effect of Product Modularity (PM):*** Overall, in reviewing the various discussions about PM and process orientation, the present research concluded that consistent with our general argument in Chapter Two, the effect of business process orientation (BPO) on internal integration (II) is affected by product architecture characteristics. The results demonstrated that PM is both an enabler and inhibitor to a process-based organisation when it comes to integration within a firm, reflecting the multifaceted implications of modularity. The findings mainly run counter to the widely expressed view that PM may result in loosely coupled organisational forms/ties (e.g. Sanchez, 1999, Baldwin and Clark, 2000, Hoetker, 2006). Our study showed that PM and BPO have synergistic effects and the use of both simultaneously increases the return on II. Particularly, the findings showed that PM could be used to further the effectiveness of BPO on cooperative communication. Additionally, consistent with the logic of the mirroring hypothesis, this research confirmed the negative effect of PM on organisation structure which consequently fades the cross-level impact of BPO on II. Therefore, certain integrative practice may become ineffective under high PM condition. Grounded on these findings, this research contends that in some situations it may be practical to combine BPO practices with product architecture characteristics aiming to promote cooperative business environment. Nevertheless, managers should not over-invest in the combination of resources supportive of process and product-oriented practices. Rather they should concisely select a few to achieve the potential benefit of BPO and PM on intra-organisation integration.

These results reflected a different decomposition logic than what was initially assumed for PM. Broadly speaking, we found that BPO has direct effects on II, independently

of PM. For our sample firms, the effects of PM and BPO represented three forms of relationship including complementary, interactive and additive. The complementary effect was identified between PMM and PM which resulted in a positive and significant relationship between PMM and CC in the presence of high modularity. PS and PM showed to have negative interaction effect on CC leading us to conceptualise their relationship as solely interactive. And, the additive effect was present between CFPVB and PM where the effect of CFPVB on CC was heightened with the rising level of modularity. These findings indicated that these firms may have relatively leveraged the architectural characteristics of a modular product in line with their organisations process approach. Although, our investigations into this area are still at early stage, they seem likely to suggest that building process approach using the concept of BPO and following the logics of modularity at a component level may contribute to more deliberate decision-making concerning integration of the value chain activities. An example is the choice to hold one individual accountable for the integral delivery of a modular product that involves tasks and skills of multiple functions. These findings informed the literature on the relationship between product architecture and supply chain management (SCM). Particularly, this line of research lacks adequate empirical studies to explain the association between PM and supply chain integration (SCI) in different directions which represent the core of our theoretical contribution. The key findings are presented in the following:

***PM Moderation Effect on the PMM-II:*** With the lack of direct effect in the relationship between PMM and CC this research contended that modularity plays a contingency role influencing this relationship. More specifically it was suggested that PM and PMM produce complementary effect on II through affecting its behavioural ground (i.e. cooperative communication) where transactional-based relationships are formed among individuals. As to this partial moderation effect, our interpretation is that the application of high modularity adds to a better management and measurement of performance metrics and their effective communication at process level while it leaves no room for its interpretation regarding the relational aspect of integration possibly because architectural decisions have the highest impact during the early stage of development process. Indeed, while the choice of modular architecture may require trade-off decisions (e.g. economic benefits of platform architecture in long-term versus the short- or long-term effect of postponing product introduction to market), and thus create conflicting metrics, it matures over the course of its development and the possibility of its consequences is reduced at later stages. For instance, decisions made at a system design stage such as defining component interfaces, developing performance targets at both component and system levels and their acceptance criteria are well-understood by teams as they are gradually embedded through recurrent tasks

implementation. From this perspective, the main difficulties are the alignment of team members' perceptions and the achievement of collective action which are mainly significant for innovative product development projects and when project team is large. However, with the current research sample dominated by SMEs it is foreseen that the team sizes are mostly small facilitating social interaction and collaboration. Additionally, with the majority adopted '*the manufacture of familiar products*' strategy the coordination of multiple performance metrics could be effortlessly enabled compared to when the nature of projects is highly innovative. Therefore, under such circumstances the implications of PM for PMM may be compensated and thus the contingency effect of modularity on the relational aspect of integration is not observed. By and large, this study contributed to a recent growing body of knowledge debating the dynamic relationship between PM and integration (e.g. Lau et al., 2010b). The evidence presented would seem to suggest that not only a modular architecture is not in counter with performance measurement principles of process approach, but also could be used as a mechanism which enables enhanced information processing capabilities across team boundaries, particularly in knowledge intensive industries, and leads to better communication. In fact, the hybrid adoption of PM and PMM in an organisation allows for the decomposition of goals and their performance indicators for teams with specific domain knowledge, which could facilitate modification of processes and enable the firm to cope with the dynamic nature of process and changes in informational needs. Additionally, it may support knowledge attainment, learning processing and speed up decision making process. Therefore, manufacturers need to heed the product architecture issues in developing process performance measurement system to improve the communication of goals and process performance. However, this picture is still incomplete and as resources synergistic performance from a resource-based view theory and contextual factors from a contingency theory (CT) perspective are important managerial and academic concerns, further research should be conducted in this domain to identify the factors that have similar impact on a firm social capital.

***PM Moderation Effect on the PS-II:*** Concurred with our initial prediction this research concluded that high modularity creates a form of misalignment in a process-based organisation which has negative consequences for communication structure. The empirical evidence confirmed that PM approach goes beyond just simply alleviating complexity and at the same time has some implications for a firm internal communication pattern. This supports the view in the existing research that product/functional-oriented structures have serious problem taking a customer perspective and in which customers play a secondary role in shaping the way operations/activities are conducted (Vanhaverbeke and Torremans, 1999). This research contributed to a large body of literature (e.g. Schilling, 2000; Baldwin and Clark,

2000; Schilling and Steensma, 2001; Salvador et al. 2002; Sosa et al., 2004; Mikkola, 2006) studying the relationship between product architecture, organisational and communication structure, and drew on the strategic importance of architectural characteristics within the context of II. Most importantly, in line with the mirroring hypothesis our research supported that a firm organisational structure corresponds to its product architecture, and communication links are organised in a way that is supportive of its product technical dependency in a system. Results demonstrated that modularity leads development teams/individuals to act and communicate in a particular manner that fits the needs of modular architecture. In this situation, it could become difficult to follow the logics of a PS held in a process-focused organisation because of the fundamentally different role attributed to customers followed by different reporting relationships formed among employees and the management. As such, this research helps to explain what operations are at the influence of PM characteristics and under what circumstance they do not add value to social interaction and communication. The managerial implication is that failure in understanding the impact of a modular product architecture on organisational and communication structure could reverse its effect on the value-adding activities, particularly in high- and medium-tech manufacturing firms. Therefore, to cope with the increasing complexity and dynamics of these business environment managers must endeavour to gain an understanding of their internal communication structure and adopt integrative practices that best serve to mitigate the effect of PM on their organisational structure.

***PM Moderation Effect on the CFPVB-II:*** While, under the direct effects, it was concluded that cultural principles promoted by BPO constitute a fundamental base for II, this study also contended that by combining PM and BPO, firms may further achieve the potential benefits of CFPVB on structural social capital (i.e. cooperative communication (CC)). Although, these findings were not consistent with our initial predictions, they provide valuable insights into the behavioural dynamics of the supply chain (SC). This research presented evidence suggesting that the combination of PM and CFPVB not only does not create cultural differences but also is managed to ensure that multiple values and insights nurture rather than stifle cross-boundary communication required for effective II. This is particularly prevalent in firms where design is a key source of competitive advantage. In fact, our results could suggest that given the prolonged nature of BPO, customer orientation becomes part of an overall corporate culture and is rooted in a broader set of values and beliefs. On that basis, we also argued that in firms with strong customer-oriented culture individuals' relation (i.e. CTPO) are long-established based on shared values, and their willingness to cooperative mindset and customer-perceived values are not undermined as a result of high modularity. The main theoretical contribution of these findings lies in an empirical analysis of the interplay of

process-based culture and PM and the examination of their synergistic effect on the dimensions of II. As a result, this research extended previous studies by incorporating product architecture factor in exploring the effect of organisational culture on integration and as such questioned the existing debates about the consequences of architectural decisions for the value chain. In other words, our results showed that, when combining the aspects of product architecture and process approach, findings are not always in line with the existing literature, therefore will leave the discussion open for future research. In addition, our findings can provide insights for managers to perceive the cultural implications of PM and help them exploit its potential benefits in cultivating collective responsibility and collaborative culture.

### **7.3. Research Contributions and Implications**

This research responded to the three research questions by providing a comprehensive model in which the relative relationship between BPO, PM and II are demonstrated. As such, it advanced the extant literature in three domains of supply chain management (SCM), operations management (OM), and business process management (BPM), while also providing some valuable practical insights for managers. The following sections aim to address the key theoretical contributions and managerial implications of the research findings.

#### **7.3.1. Theoretical Contributions**

As for the BPO-II relationship, the overall supported hypotheses represent the core of the theoretical contribution. In fact, our study is the first to theorise II from a process perspective, using the notion of BPO, and our model provides the first step towards prescribing the factors providing the underlying basis of II. Although, the extant studies have echoed the significance of process orientation in various aspects of an organisation, such as IT and performance implications, inventory and logistics operations (e.g. Vera and Kuntz, 2007, Škrinjar et al., 2008, McCormack et al., 2009, Miri-Lavasani and Movahedi, 2018, Schmidberger et al., 2009, Chikán, 2009), research still lacks clear insight into the practice of process approach for an intra-firm integration. Specifically, it has been argued that BPO is related to business performance and helps companies to improve “esprit de corps” and reduce cross-functional conflicts. Yet, empirical evidence has not been provided on a wider level including its benefits for behavioural and relational social capital. Thereby, this research differentiates itself from previous studies, and by doing so it further expands on this line of research and contributes to the field not only by proposing a new approach for achieving II, but also by identifying the most effective configuration of the model’s dimension to obtain the best results.



Indeed, by taking a contingency approach to investigate the relationship between BPO and II and drawing on the competing model approach this research proposed three alternative BPO\_II models. Results provided support for the contingency theory (CT), demonstrating that in the context of high- and medium-tech manufacturing firms, the three models exerted different effects on II, with the Parallel Model accounted for the most effective development pattern of BPO elements. It was recognised that the emphasis placed on the effectiveness of process approach dimensions varied with different factors constituting the ground of integration (i.e. relational and behavioural structures). Therefore, the influence of the role of each BPO factor changed for different scopes of integration, while their relative interdependence remained intact. The research then claims that different composition of the BPO development should be considered when examining various integrative practices. This approach has the potential to explain how the best-fitting model could be achieved in different contexts and improve the understanding of scholars of the complexities involved in the development of process view, particularly when it comes to managing behaviours and attitudes. The framework could also be used and further extended to include other forms of integration (supplier and customer integration) to tease out their relationship with BPO.

This research further supports the existing literature on the multi-dimensional nature of II by identifying it as multifaceted construct constituting cooperative task planning orientation (CTPO) and cooperative communication (CC) (Kahn, 1996, Ellinger, 2000, Vallet-Bellmunt and Rivera-Torres, 2013). While a great deal of the research has limited the conceptualisation of II to information/technology integration, this research highlighted the importance of human-related aspects of integration, suggesting that the alignment of their actions (CC) is as important as the alignment of their orientation/interest (CTPO). Thereby, the present work builds on the relational and behavioural aspects of integration suggested by a recent research stream (Kahn, 1996, Lockstroem et al., 2010, Ghobadi and D'Ambra, 2012, Vallet-Bellmunt and Rivera-Torres, 2013). Thus, this research is a response to a large body of research highlighting the central role of human element in exercising integrative practices (e.g. McCarter et al., 2005, Ellinger et al., 2006, Gino and Pisano, 2008, Bendoly et al., 2010, Croson et al., 2013, Tangpong et al., 2014, Wieland et al., 2016).

Regarding the implications of product modularity (PM), literature has long emphasised that decisions about product architecture and supply chain (SC) design are deeply intertwined. Except in a few cases (e.g. Baldwin and Clark, 2000, Lau et al., 2010b) research has paid little attention to the implications of product architecture for integration. Specifically, literature is mainly dominated by studies investigating the effect of integration on product development issues. By conceptualising PM as an influencer, rather than being influenced by SCM practices which is a common trend in the literature, this research went beyond existing studies and provided empirical evidence on the impact of modular product architecture on the

BPO\_II relationship. As such, it makes a unique contribution to the management literature on the role of product architecture in SC decisions which is still underrepresented, and adds to a better understating of how PM is related to organisational design, which is a controversial area studied by a large body of research (e.g. Schilling, 2000, Baldwin and Clark, 2000, Salvador et al. 2002, Sosa et al., 2004, Mikkola, 2006). Additionally, the findings supported the underlying assumptions of our theoretical lens (i.e. contingency theory (CT)) by confirming that firms effectiveness in their strategy implementation depends on the fit between their structural characteristics (e.g. division of labour) and the contingency factors, such as the characteristics of the context in which they operate.

Against generally held assumption that PM creates a loosely coupled organisational form, our findings suggested that the merits of its architectural properties can contribute, to some extent, to effective execution of process approach practices, which, in turn, engender behaviours supportive of integration. At the same time, our research further supported the mirroring hypothesis and reinforced the interpretation that product architecture has a reflection on an organisational structure and consequently has structural consequence for the value chain activities. This finding has major implications for scholars who take an opposite view and argue that modular product architecture does not necessarily reflect a modular organisational structure (Campagnolo and Camuffo, 2010). However, considering the cross-sectional nature of the data collection this result must be interpreted with caution.

By analysing this moderation effect, this research provided an opportunity to identify the synergies between PM and BPO which should be considered by managers and decision makers, particularly in knowledge intensive industries, to achieve an effective II. Thus, this research empirically unfolds the effect of achieving a threshold of modularity, while also developing BPO practices, on II. By doing so, this empirical research reveals the implications of a modular product development in such complex and dynamic business environments, confirming there is a relationship between product architecture and organisation's communication structure. In particular, this research suggested that product architecture plays a key role when assessing a manufacturing firm's communication structure. These implicate the prominent role of product architecture in theory development in the field of SCM given the growing application of both modularity and integration in the manufacturing industry. Our study also draws attention to focus not only on modular product architecture as a constraint but also as a resource which indirectly stimulates cooperative behaviours.

The significant moderation effects also contributed to the research into the nature of PM. Notably, the results contend that modularity is a matter of degree and depending on the level of its adoption, the consequence of PM varies for the structure of decision making in the domain of supply chain (SC). Nevertheless, the matter of product complexity remains this question open for future research to investigate whether the level of complexity alters these

results as the inclusion of this variable in the study could shed more light on how the research framework behaves depending on the extent of product complexity (e.g. Caniato and Größler, 2015, Vickery et al., 2016).

### **7.3.2. Managerial Implications**

The findings of this research have considerable managerial implications in high- and medium-tech manufacturing firms. Investigating the relationship between BPO and II merits special consideration in managerial decision making and structural issues in such complex and dynamic businesses. A thorough understanding of a process approach and its underlying practices can aid managers to more effectively exercise integrative mechanisms and techniques in practice. In addition, by incorporating PM into the model, this research offers further practical implications to both firms aiming to adopt modular product architecture and also those which are currently developing modular product.

Given the significant relationship between BPO and II, the practical implication of this research lies in proposing practical solution for managing integration across multiple functions through developing BPO. Enhancing SC visibility is a key challenge faced by managers who seek to make the most of their value-adding activities. It is believed that this research is an excellent initial step towards enlightening the multifaceted managerial benefits of process management within the context of II, allowing for improved and end-to-end visibility across SC if established properly. As companies strive to attain higher levels of process orientation, they can improve their relationship with their key stakeholders and their adaptability to changing circumstances. Certainly, such an environment is a catalyst for better cooperation and communication of knowledge and information and creates strong social connections between employees. Therefore, a process approach may be used to remove cross-functional barriers “by creating a community of employees linked by membership of a process” (Llewellyn and Armistead, 2000, p.225). Managers, then, need to familiarise themselves with this concept and its implementation issues and complexities. In addition, empirical evidence leads us to suggest that product architecture may be a factor that is responsible for functional silos which still appears to be a barrier for a coordinated approach. Therefore, organisational decision regarding the number and size of project teams and the adoption of integration mechanism should be planned in parallel with the product architecture decisions, and their likely consequences are taken into account to avoid disconnection across the company.

Managers may apply the model in different ways. First, they can use it as a guideline to focus on process-oriented decisions critical for the development of different aspects of II and also enable it across key business processes. Second, for process and product strategies, it can help them identify and control the merits and limitations of modularity for the

implementation of a given process practice which can contribute to effective problem-solving, the development of shared values, and cross-boundary relationships. As such, it helps them focus on key practices during product architecture decision making process to best serve intra-firm integration objectives. For example, following the logics of product modularity may lead to a modular structure in a firm to support its underlying technical needs which may slow down coordination efforts resulted from BPO. In this situation, BPO may not add sufficient value to the firm coordinated approach because modular architecture is not compatible with process structure and could make it difficult to break away from product-oriented structure. Third, the research framework can provide managers with an initial guidance on the appropriate mix of PM and BPO practices to achieve the most effective II and as such improve their integration capabilities over time.

While this research included both SMEs and large manufacturing firms to substantiate claims and incorporate multiple perspectives, the findings highlight important remarks, particularly, for SMEs which formed the majority of our participants. It is important to move from this wrong perception that SMEs are not diversified in their daily-basis processes and are less likely to need process-oriented optimisation. The very survival of SMEs in high- and medium-tech industries is reliant upon their ability to cope with the increasing complexity and dynamics of their supply chain. Our empirical results illustrated that BPO can greatly assist them in improving their value-chain visibility and ensuring effective coordination and integration of efforts across departments which form the basis of an extended supply chain integration (SCI). The incorporation of product architecture considerations into their process view can further support their value-chain optimisation and integration. In fact, financial and human resource constraints in SMEs prevent them from the investment in the planning and implementation of integration system. Therefore, hybrid of process and product view allows them to combine the strengths of both approaches upon which they can better serve their various customers and respond to diverse collaboration needs with their supplier and key stakeholders.

#### **7.4.Limitations and Future Work/Opportunities**

While the results of this research offer significant insights for both academics and practitioners, it also involves some limitations and proposals for future research. This section reports on some known limitations related to the adopted methodology, data collection instrument, as well as some practical and theoretical aspects of the research.

Taking a critical realism approach, this research aimed to uncover the relationship between BPO, II and PM. It is argued that, despite the contribution of critical realism approach in explaining the causal relationships in quantitative research in social sciences, the model

must be reproduced in a different context with different datasets to account for unobserved variables and further validate the theoretical model. While, a series of steps were taken to address internal validity issue which is pertinent to the research instrument reliability in establishing the causal link between variables, findings cannot be generalised to other contexts. Thus, external validity is limited due to the context-dependent nature of knowledge generation in critical realist approach. Therefore, the application of the instrument must still be validated in dissimilar populations. With the use of critical realism approach, this research is limited to generalise (i.e. external validity) the findings across the entire target population, thus the findings are confined to the context of this research. To achieve a greater explanatory power in the model further works need to be carried out to assess the theoretical hypotheses using different datasets.

The findings are subject to the usual limitation inherent in cross-sectional research and the use of single informant. While, cross-sectional data has merits in establishing the relationship between variables, to generalise the findings a longitudinal study is suggested. For example, given the developmental nature of BPO, future research could consider a firmer level of analysis, conducting a longitudinal data collection in order to evaluate the relationship between BPO and integration over a long period of time. Likewise, the cross-sectional nature of our study precludes us from detecting the possible lag effects of PM on organisational structure and communication patterns. As such, our study may have failed to detect effects for firms who recently adopted modular architecture as it might take several years to change product architecture and achieve maturity in PM. For this reason, the findings must be interpreted with caution. Nevertheless, the framework as well as the contributing factors represented in this research could serve as an informative tool which could be used by firms who are at the initial stage of introducing modular architectures and are conscious of the importance of retaining or even enhancing the level of their II.

In terms of the sample characteristics, the FAME database limitation was argued in representing the true population of the five manufacturing sectors adopted in this research. Interestingly, a few participants stated that they were not a manufacturer and had been categorised under wrong industry sector, raising a concern with the database reliability. This issue was, yet, resolved by cross-checking firms information, which was extremely time-consuming. Despite these recognised limitations, FAME had been the only platform which provides academic access to the UK companies, and as agreed by Department for Business, Energy & Industrial Strategy there is no single database which contains detailed information on all the UK private sector organisations. In addition, as for time and cost constraints, this research was limited to employ certain types of measurement instruments (e.g. survey method) to enquire into the theoretical account. These practical limitations confined this research to expand the investigation and include interview as a complementary source of data collection.

A qualitative method could further produce valuable insights into the theoretical model. For example, future studies on the current topic are recommended to employ field-based research methods (i.e. case studies), in order to address the growing complexities and changes in managerial practice and technology. An interesting topic for future research could be a case study investigating the effect of PM on the BPO-II relationship in firms with different levels of product complexity. This appears to be an avenue worth pursuing further by integrating quantitative and qualitative method to better identify the generative mechanisms that cause the proposed relationship.

This research is theoretically limited to the inclusion of II in the model. So, future research may build upon the present study by also including external integration into the model. More broadly research is also needed to investigate the relationship between BPO and other forms of integration (i.e. supplier and customer integration). Likewise, it would be worth examining the three competing models in an extended SCI and further extend on the current theoretical framework for future research. Equally important is studying the concept of PM, examining how the interaction of BPO and PM would affect external integration through II. Moreover, research into this topic could further be expanded by investigating the effect of this relationship on performance objectives.

Although, it is argued that contingency theory could yield valuable insights in OM research specially in less-developed areas, it is suggested that due to cross disciplinary nature of OM the use of alternative theoretical lenses taken from other fields could also be fruitful. Incorporating alternative theories could be useful to address the limitations of contingency theory. It could be argued that the use of contingency theory per se is not sufficient to explain the underlying pattern of the BPO-II relationship. While contingency approach believes in contingencies and their influences to determine an adequate fit, it does not take into account the role of decision makers and their influences on their contextual situation. This approach leaves little scope for free managerial choice. On that basis, strategic choice theory (SCT) is suggested as a complementary theory to also account for managers choice in organisational design. Therefore, by integrating contingency theory with other theoretical perspectives borrowed from other disciplines (e.g. SCT, dynamic capabilities, resource-based view (RBV)) future research could better observe the pattern of BPO, II and PM relationship and enrich the theoretical foundation. This will allow to uncover how II responds to the logics of process approach and PM. For example, due to the changing nature of business processes managers must continuously adapt to the new situation and align them with the need of II according to dynamic capabilities theory. In addition, RBV theory could also look at the complementary effect of BPO and PM on II, as some of the findings in this research also suggested.

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## Appendices

### Appendix 2.1. A Review of Various Definitions and Conceptualisations of Integration

Articles/Book	Year	Authors	Internal Focus	External Focus	Supply Chain Integration (SCI) Focus	Focus of study
<b>The impact of human capital on supply chain integration and competitive performance</b>	2016	Huo et al.			Internal integration (collaborative and synchronized processes, information sharing across functional areas, strategic cross-functional partnerships, and team work, working as an integrated process across various functions), supplier integration, and customer integration	Operationalised SCI to include internal, supplier, and customer integration to explore the effect of human capital on SCI and competitive performance.
<b>Internal integration as a pre-condition for external integration in global sourcing: A social capital perspective</b>	2014	Horn et al.			Internal or cross-functional integration (coordination, interaction, communication, information sharing, joint involvement across functional areas), and external or supplier integration (high coordination across the boundaries of organizations, i.e. buyer-supplier coordination)	Operationalised SCI to include internal and supplier integration, to identify the association between each of integration dimension with global sourcing success and the role each plays in international operations.
<b>The effect of teams on customer knowledge processing, esprit de corps and account performance in international key account management</b>	2013	Salojärvi & Saarenketo	Regular team meeting (cross-functional communication), mutual understanding across functions, team membership, sense of ownership, intra team coordination, the development of esprit de corps among employees, coordination and integration of sales activities, establishment of key account team, coordination of customer-			With the main emphasis on supplier firms to analyse the influence of key account management on 'international key account customers', this paper highlights the importance of teams in facilitating "coordination and integration of sales processes"

			specific knowledge flow			
<b>The impact of supply chain risk on supply chain integration and company performance: a global investigation</b>	2013	Zhao et al.			Internal integration (function integration, team work and information integration) and external integration (communication and collaboration with customers and suppliers)	Operationalised SCI to include internal and external integration to find out their influence on a firm performance
<b>Supply chain integration framework using literature review</b>	2013	Alfalla-Luque et al.			External integration (supplier and customer integration) and internal integration (information and material flows integration, and process integration)	To determine the elements of SCI
<b>The impact of upstream supply and downstream demand integration on quality management and quality performance</b>	2012	Sun & Ni			Upstream integration, with suppliers, and downstream integration, with customers	Operationalised SCI to include suppliers and customers integration to investigate the effect of SCI on performance. It does not disregard internal integration in its analysis and based on the empirical results it highlights the important role of internal integration and suggests that internal and external integration have complementary relationship. It refers to internal integration as a practice which "focuses on functional integration of quality, production, marketing,

						engineering et al. within a manufacturer" (p. 884)
<b>Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration</b>	2012	Prajogo & Olhager			Information and logistics (material flow) integration	Focusing on the external elements of SCI to investigate the effect of material flow and information integration on SCI and firm operational performance
<b>The impact of supply chain integration on company performance: an organizational capability perspective</b>	2012	Huo			Internal integration (information integration, inventory management, cross-functional team and meetings, and "real-time integration and connection among all internal functions from raw material management through production, shipping, and sale" (p. 609)) and external integration (customer integration and supplier integration, i.e. information exchange/integration, communication with customers and suppliers, strategic partnership, collaboration)	To discover the influence of SCI dimensions on three types of firm performance
<b>Supply chain integration and efficiency performance: a study on the interactions between customer and supplier integration</b>	2011	Danese & Romano			Suppliers and customers integration (openness in communication and collaboration, cooperative relationship with suppliers, close communication with suppliers and customers, work as a partner with customers, considering customers' forecast in supply chain planning, and etc. (p. 224))	Operationalise d SCI to include supplier and customer integration, to explore the impact of customer integration on efficiency, and analyse the moderating role of supplier integration in the relationship between customer integration and efficiency.
<b>The contingency effects of environmental uncertainty on the relationship between supply chain integration and operational performance</b>	2011	Wong et al.			Internal integration (collaboration across functional areas, i.e. product design, procurement, production, sales, and distribution) and external (supplier and customer integration)	Operationalise d SCI to include internal, supplier, and customer integration to investigate the contingency impacts of environmental uncertainty on the relationship between SCI



						and operational performance
<b>The moderating effects of technological and demand uncertainties on the relationship between supply chain integration and customer delivery performance</b>	2011	Jonsson et al.			Internal integration and external integration (customer and supplier integration)	Considering three dimensions of SCI to examine the moderating effect of environmental (i.e. demand and technological) uncertainty on the relationship between SCI and delivery performance
<b>A Dynamic Collaboration Capability as a Source of Competitive Advantage</b>	2011	Allred et al.			Supply chain collaboration: Internal collaboration (process-oriented performance measures, information integration, cross-functional collaboration, middle managers empowerment, workers empowerment) and external collaboration	To investigate the relationship between supply chain collaboration capabilities and operational and firm performance.
<b>The impact of internal integration and relationship commitment on external integration</b>	2011	Zhao et al.			Internal integration and external integration (customer and supplier integration)	Conceptualize d SCI to include internal and external integration to uncover the relationship between them and identify the factor influencing SCI and its dimensions
<b>Supply chain integration mechanisms for alleviating supply problems in manufacturing firms</b>	2010	Primo			Internal integration (functional interaction between purchasing and manufacturing), and external integration (including cooperation from firm's external customers (p. 47)	promoting the implementation of internal and external integration, this study identified internal and external supply chain integration mechanism, e.g. forecast integration, cross-functional meeting, and etc.
<b>Investigating the impact of organizational culture on supply chain integration</b>	2010	Braunscheidel et al.			Internal integration, external integration with key suppliers and key customers	Explored the impact of organizational culture on internal, supplier and customer integration

<b>Organizational Integration for Product Development: The Effects on Glitches, On-Time Execution of Engineering Change Orders, and Market Success</b>	2010	Koufteros et al.			Internal integration) cross-functional integration) and external integration (customer integration and supplier product/process integration)	Within the context of new product development, the study aims at discovering the vital role of internal integration on facilitating the integration with external partners (suppliers and customers)
<b>The impact of supply chain integration on performance: A contingency and configuration approach</b>	2010	Flynn et al.			Internal integration (collaborative and synchronized processes) and external integration (customer and supplier integration)	Extending on previous incomplete studies, defining SCI to include both external and internal integration to investigate the relationship between SCI and operational and business performance
<b>The human impact on supply chains: evaluating the importance of “soft” areas on integration and performance</b>	2009	Shub & Stonebraker			Treated SCI as one construct	To find out the relationship between human resource strategies and organization strategies with SCI and performance
<b>Defining and operationalising supply chain process integration</b>	2009	Chen et al.			Internal process integration (i.e. internal process connectivity and internal process simplification) and external process integration (i.e. external process connectivity and external process integration)	Conceptualize d internal and external integration, taking a process approach, to provide a framework to operationalise integration
<b>Relative effects of design, integration and information sharing on supply chain performance</b>	2008	Sezen			Treated SCI as one construct	To study the effect of SCI on supply chain performance
<b>A critical review of survey-based research in supply chain integration</b>	2008	van der Vaart & van Donk		Focused on external factors	SCI dimensions: Attitude, practice, patterns	Synthesizing 33 survey studies to conceptualize the dimensions of SCI
<b>Supply chain coordination: Perspectives, empirical studies and research directions</b>	2008	Kanda & Deshmukh			supply chain coordination/cooperation/ collaboration	A literature review paper reporting on the various aspects of supply chain coordination

<b>Cross-Functional Integration and New Product Success: An Empirical Investigation of the Findings</b>	2008	Troy et al.	Cross-functional integration (communication and interaction frequency, and information sharing either at team or organizational level)			Defined internal integration as cross-functional integration within an organization and identified main moderators affecting the relationship between cross-functional integration and new product success. product or service)
<b>An empirical study of the impact of e-business technologies on organizational collaboration and performance</b>	2007	Sanders			Intra-organizational integration and inter-organizational integration	An empirical study differentiating from other past studies in that it operationalised collaboration to include intra- and inter-organizational collaboration and examine the effect of e-business technologies on the two dimensions of collaboration construct
<b>Relationship between supply chain performance and degree of linkage among supplier, internal integration, and customer</b>	2007	Lee et al.			"Linkage among supplier, internal process, and customer to facilitate information flow of inbound and outbound flow of information and goods/services." (p.445)	To identify the relationship between supply chain linkages and performance across the chain
<b>Extending green practices across the supply chain</b>	2006	Vachon & Klassen,			Logistics integration and technological integration (upstream and downstream interaction)	To identify the determinant practices of supply chain integration (technological and logistics integration with suppliers and customers) as the antecedents of green practices
<b>The interaction of internal and downstream integration and its association with performance</b>	2006	Germain & Iyer			Internal integration ("interdepartmental committees, cross-functional teams, and inter-functional liaison personnel" (p.41) and downstream integration	To analyse the 'interactive effect' of internal integration and downstream integration on different aspects of a firm performance, including

						financial and logistical
<b>Supplier integration— Finding an optimal configuration</b>	2006	Das et al.			Supplier integration (internal and external integration practices)/Internal integration includes purchasing's involvement in corporate strategy formulation and purchasing's joint establishment of major goals with manufacturing	Operationalise d supplier integration to include internal and external integration practices to develop an optimal configuration model which can lead to a superior performance.
<b>Logistics integration processes in the food industry</b>	2006	Gimenez			Internal integration (collaboration, coordination, sharing of ideas/information/resources, cross-functional teams, and integration of logistics with marketing and production, i.e. Logistics production and logistics marketing integration), and external integration (logistics integration with suppliers and customers)	Taking a logistics perspective to integration, this paper assesses the process of integration for an organization to achieve high level of SCM.
<b>Supply chain management integration and implementation: a literature review</b>	2005	Power			Supply chain process integration (i.e. Joint collaboration between suppliers and buyers, product development partnership, etc.)	A literature review focusing on supply chain integration practices and approaches to address issues related to key business process across firms' boundaries. These approaches are "improved communication, partnerships, alliances and cooperation".
<b>Internal and External Integration for Product Development: The Contingency Effects of Uncertainty, Equivocality, and Platform Strategy</b>	2005	Koufteros et al.			Internal integration (concurrent engineering)/ external integration (both supplier process/product integration and customer integration)	The study posits internal integration as an important precursor for effective external integration

<b>Supply chain integration and performance: US versus East Asian companies</b>	2005	Graham et al.			Internal integration and external integration	To investigate the interdependencies of supply chain operations, including internal processes and external elements of supply chain, i.e. suppliers and customers
<b>Logistics-production, logistics-marketing and external integration – their impact on performance</b>	2005	Gimenez & Ventura			Internal integration (intra-organizational, viewed as the extent of logistics integration with production and marketing) and external integration (inter-organizational)	To examine the causal effect of the relationship between the dimensions of integration on firm's logistical service performance
<b>Understanding the factors that enable and inhibit the integration of operations, purchasing and logistics</b>	2004	pagell	Internal integration across operations, purchasing and logistics			To investigate the main drivers of ISCI through developing a model to include culture, communication, structure, measurement and rewards, facility layout, and job rotation and cross-functional teams
<b>The effects of internal versus external integration practices on time-based performance and overall firm performance</b>	2004	Droge et al.			Internal integration (within the context of design-process integration, including concurrent engineering, design for manufacturability, standardization, and CAD/CAM) and external integration (within the context of strategic design integration, including supplier development, supplier partnership, and closer customer relationship)	Categorizing integration into 1) internal design-process integration and 2) external strategic design integration to test their effect on time-based and overall firm performance
<b>Towards a theory of supply chain management: The constructs and measurements</b>	2004	Chen et al.			Coordinated supply chain is regarded as having logistics integration (integration between the flow of materials and information), cross-functional integration and supplier involvement/integration in place	

<b>Linking strategy, structure, process and performance in integrated logistics</b>	2004	Rodrigues et al.			Internal integration and external integration (i.e. logistics operations integration)	Operationalise d supply chain logistics integration to include internal and external operation integration in order to examine their effect on performance
<b>Understanding the meaning of collaboration in the supply chain</b>	2004	Barratt			Supply chain collaboration with the focus on vertical collaboration only (collaboration across functions, suppliers and customers collaboration, which comprises three elements, namely strategic elements (technology, the development of the business case for collaboration, intra-organizational support, and corporate focus), implementation elements (cross-functional activities, process alignment, joint decision making, supply chain metrics), and cultural elements (trust, mutuality, information exchange, and openness and communication) (derived from Figure 5 on page 36)	Discovered the main elements of supply chain collaboration, by proposing a supply chain segmentation approach.
<b>Towards a theory of supply chain management: the constructs and measurements</b>	2004	Chen & Paulraj		External logistics integration (integration of materials and information), it also mentions that the same integration could exist within internal supply chain		Having a logistics perspective to integration, this paper develops many other constructs as the main elements of SCM, e.g. cross-functional teams, supplier involvement, customer focus, long-term relationship, and communication, which have frequently been operationalised in other papers as the elements of integration.
<b>The influence of an integration strategy on competitive capabilities and business performance: An</b>	2003	Rosenzweig et al.			Internal integration and external integration	Going beyond external integration to include internal integration (manufacturing

exploratory study of consumer products manufacturers						-based capabilities) and investigate its mediating role on the relationship between SCI and business performance
Supply chain management as a competitive advantage in the Spanish grocery sector	2003	Gimenez & Ventura			Internal logistics integration (the extent of logistics activities with other functional area within an organization), and external logistics integration (logistics activities across organizations' boundaries)	Having a logistics perspective to integration, this paper develops a model to examine the relationship between internal and external integration and their effect on a firm performance.
The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships	2003	Vickery et al.			Internal integration (horizontal/cross-functional integration within the firm) and external integration (supplier/upstream and customer/downstream integration)	Defining SCI to include external (supplier/upstream and customer/downstream) integration and internal integration to test the effect of SCI on firm performance, considering the mediating effect of customer service on this relationship
The rhetoric and reality of supply chain integration	2002	Fawcett & Magnan			Internal integration, i.e. cross-functional process integration), backward integration with valued first-tier suppliers, forward integration with valued first-tier customers, and complete forward and backward integration	Empirically explored the experience and perception of industry managers to identify a precise view of SCM in practice
The knowledge of coordination for supply chain integration	2002	Simatupang et al.			Coordination across organizational borders which comprises 4 elements: "Logistics synchronization, information sharing, incentive alignment, and collective learning" (p. 293)	Based on two dimensions of coordination, namely operational and organizational linkages, developed a comprehensive framework of coordination modes for SCI to achieve superior supply chain performance

<b>Effect of supply chain integration on the relationship between diversification and performance: evidence from Japanese and Korean firms</b>	2002	Narasimhan & Kim			Internal integration (system-wide information system integration among internal functions, data integration, integrative inventory management, interdepartmental meetings, and interaction among internal functions) and external (supplier and customer) integration	Operationalise d SCI to include internal, supplier, and customer integration to assess the impact of SCI on the relationship between product diversification and an organization performance.
<b>Value Creation Through Supply Chain Management (Book section)</b>	2002	Ronald Kopicki			Refers to integrating internal process management through operational coordination, information sharing, and mutually supportive work assignments (p. 151)	
<b>Arcs of integration: An international study of supply chain studies</b>	2001	Frohlich & Westbrook		supplier integration and customer integration/integration operationalise d by 8 different types of practices, i.e. "access to planning system, sharing production plans, joint EDI access/networ ks, knowledge of inventory mix/levels, packaging customization, delivery frequencies, common use of logistical equipment/con tainers, common use of third-party logistical services" (p. 198)	upstream and downstream supply chain integration	An empirical study investigating supply chain integration strategies in manufacturer's firms
<b>The impact of purchasing integration and practices on manufacturing performance</b>	2001	Narasimhan & Das	Purchasing integration			Considering the various dimensions of supply chain integration, i.e. logistics and distribution integration, information integration, supplier integration, and customer integration, the main focus of this study lies on purchasing integration as



						an internally focused integration mechanism
<b>Performance Benefits of Supply Chain Logistical Integration</b>	2001a	Stank et al.			Internal integration (i.e. cross-functional, unification, standardization, simplification, compliance, structural adoption), customer integration, supplier integration, technology and planning integration, measurement integration, and relationship integration	To analyse the relationship between the dimensions of supply chain logistics integration and overall firm performance
<b>Improving marketing/logistics cross-functional collaboration in the supply chain</b>	2000	Ellinger	Collaborative cross-functional integration between marketing and logistics			Focusing on internal integration, i.e. marketing and logistics collaboration, this paper proposes a model to analyse the relationship between 4 elements, namely "organization's evaluation and reward system, cross-functional collaboration, effective marketing/logistics interdepartmental integration, and distribution service performance" (p. 85)
<b>Supply chain management: implementation issues and research opportunities</b>	11998	Lambert et al.			SCI is defined as the management of key business processes. Internal coordination amongst activities within an organization is an element of successful SCM, and is an integral part of SCI	To develop a framework to implement SCM through characterizing the supply chain consisting of key business processes which need to be integrated.
<b>Supply chain integration: customer value through collaborative closeness versus operational excellence</b>	1998	Morash & Clinton			Three forms of SCI including intra-organizational process integration (between production, logistics, and marketing), inter-organizational collaborative integration including strategic	Explored and compared three dimensions of SCI

					alliances, and operational excellence (p. 104)	
<b>Logistics, strategy and structure: a conceptual framework</b>	1998	Stock et al.		Internal integration (logistics integration across functional boundaries, increased communication and coordination between logistics activities and other functional areas), external integration (logistics integration and the extent of logistics activities across organization's boundaries)		Developed a conceptual model to explore the expanded role of logistics in a manufacturing firm, emphasising on enterprise-wide logistics integration.
<b>Logistics and interdepartmental integration</b>	1996	Kahn & Mentzer			Inter-departmental integration with the elements of interaction and collaboration/ external integration (supplier and customer integration)	Operationalised logistics integration within the context of inter-departmental integration
<b>Market orientation: antecedents and consequences</b>	1993	Jaworski & Kohli	Interdepartmental connectedness			Developed a framework to identify the antecedents and consequences of market orientation. Among the elements, interdepartmental connectedness was included.
<b>A Survey of Major Approaches for Accelerating Product Development</b>	1992	Millson et al.	Concurrent engineering (linking process R&D and new product R&D (i.e. integrated R&D), monitoring processes in a holistic manner, information sharing, developing linkages between marketing,			To investigate the techniques that help to reduce NPD cycle time.

			engineering , and manufacturing decisions, team work among functional areas, simplifying manufacturing activities by deploying new technology and eliminating parts)			
<b>The Purchasing-Logistics Interfaces: A “Scope of Responsibility” Taxonomy</b>	2010	Ashenbaum B. & Terpend	Purchasing-Logistics interfaces			To investigate the ways purchasing-logistics interfaces are structured
<b>Identifying Barriers to Internal Integration Using Systems Thinking</b>	2012	Bakket et al.	Internal supply chain integration			To identify the barriers to internal supply chain integration as well as their underlying causes, employing systems thinking approach
<b>Supply chain Management Resources, Capabilities and Execution</b>	2014	Kotzab et al.			Intra- and inter-organisational management resources (flow of goods, flow of information, management of cooperation through business processes synchronisation and integration)	To develop a conceptual framework proposing the management resources and capabilities affecting the implementation of SCM
<b>Bridging the Divide Between Logistics and Marketing: Facilitating Collaborative Behaviour</b>	2006	Ellinger et al.	Logistics-marketing collaborative behaviour			To develop a conceptual framework proposing the inhibitors and facilitators of logistics-marketing cooperative behaviours

## Appendix 4.1. Sample of the Refined Questionnaire

### Section A. Research Information and Consent Form

Thank you for agreeing to participate in this research which investigates the factors that affect the level of internal supply chain integration in the UK manufacturing sector.

My name is Vajihe Javadian, a PhD student at Royal Holloway, University of London, and I am conducting this survey to gain some insights into how a manufacturing organisation can achieve a high level of collaboration and integration across several functions by focusing on its key business processes involved in the development of products. I am interested in studying how functions' structure and relations informed by some management practices would affect the level of this integration. This survey will be gaining your thoughts and opinions to improve the understanding of the techniques employed within high- and medium-technology manufacturing firms in the UK to promote a more collaborative and integrative environment.

This survey would take up to 10 minutes to complete. Be assured that all the answers you provide will be kept in the strictest confidentiality. For further information please contact the researcher at pbtm006@live.rhul.ac.uk.

Please indicate your consent if you agree to participate in this study. I consent to participate:

- ☐ Yes
- ☐ No

### Section B. Screening Questions.

1. For how long have you been employed with the current company?
  - ☐ Less than 1 year
  - ☐ More than 1 year
2. Do you believe that you have been involved in at least one of the following key business processes within your organisation (you may select more than one option if you have been involved in multiple processes):
  - ☐ Demand creation
  - ☐ Design and development
  - ☐ Pre-construction
  - ☐ Project fulfilment
  - ☐ Post-project management
  - ☐ None of the above

### Section C. Company Background

1. Please indicate the name of your company:
2. Please indicate your business expertise area in the manufacturing industry:
  - ☐ Manufacture of computer, electronic and optical products
  - ☐ Manufacture of electrical equipment
  - ☐ Manufacture of machinery and equipment n.e.c.
  - ☐ Manufacture of motor vehicles, trailers and semi-trailers
  - ☐ Manufacture of other transport equipment. Please specify:
  - ☐ Other. Please specify:
3. Please specify if you are a supplier or an OEM:

- Supplier. Please specify, i.e. Tier 1 supplier, Tier 2 supplier ...
- OEM
- Other. Please specify:

4. Please indicate your company's operational size?

Approximate number of employees

Approximate annual sales

5. Please indicate where your company is located?

6. Please indicate the functional area that you operate in (you may select more than one function if you are involved in multiple functional responsibilities):

- Research & Development (R&D)
- Marketing & sales
- Logistics
- Finance
- Purchasing
- Production
- After sales services
- Other (please indicate)

7. Which of the following best describes the main production approach of your organisation? please select all that apply.

- Manufacturing familiar products to the organisation in low volumes (Familiar products are the ones with specifications and structures familiar to both manufacturer and its customers)
- Manufacturing familiar products to the organisation in high volumes
- Manufacturing new-to-the-organisation-products in low volumes (new-to the-organisation-products are the ones with unknown specifications and structures to both manufacturer and its customers)
- Manufacturing new-to-the-organisation-products in high volumes

8. What is your job title in this company (e.g. CEO, General Manager, Director, Operations Manager, Operational Level Employee, etc.)?

9. Please provide your email address before continue if you would like to be entered into a prize draw to win £50 worth of Amazon vouchers:

## **Section D. Introduction**

The following questions ask you to comment on your organisation. What I wish to know is how you perceive your organisation as to the way it is structured to accomplish the development, manufacturing and delivery of a component to your customer. Each question will ask you to indicate the level of your agreement to the statements based on the following scales.

As already indicated, I would like to understand how the key business processes involved in the development of components in your organisation would affect the level of collaboration and integration across the different key functions, such as R&D, marketing, production, logistics, etc.

Please note that the following sections should be answered based on your general opinion on the key business processes involved in the development of components within your organisation. As indicated in the screening question, the key business processes refer to demand creation, design and development, pre-construction, project fulfilment, and post-project management and include both functional and cross-functional processes.

## Section E. Questions on Process Job

1. To what extent do you agree with each of the following statements with regards to the jobs which are involved in the key business processes within your organisation?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Jobs are usually multidimensional and not just simple tasks in these processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jobs include frequent problem solving in these processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Employees are constantly learning new things on the jobs which are involved in these processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. To what extent do you agree with each of the following statements with regards to the process owners/managers of the key business processes within your organisation?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
A process owner/manager, who takes the overall responsibility and authority of the process, has been assigned to each key process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Process owners/managers are experienced leaders/managers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The management of our organisation perceives process management not as a single project but as a way of managing the business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Management is committed to reviewing and improving the processes in line with the business needs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. To what extent do you agree with each of the following statements about the senior executive with regards to the key business processes within your organisation?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
There is at least one senior executive who has taken leadership of and responsibility for the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The senior executive team is actively engaged in the key business processes program	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please feel free to make any comments or observations that you consider important and relevant regarding the above questions:

## Section F. Questions on Process View

1. To what extent do you agree with each of the following statements with regards to your understanding of the key business processes within your organisation from input to the output?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Employees often view the business as a series of linked processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Process terms (input, output, process and process owners) are used in the conversation made between individuals across the organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The key business processes are defined and documented by using the terms "inputs, outputs, to and from our customers"	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The key business processes are sufficiently defined and shared with employees by managers so that most employees know how they work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is a 'system view' in place (i.e. the entire process is managed)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. To what extent do you agree with each of the following statements with regards to the management approach to the key business processes within your organisation?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Management tries to eliminate resistance to change by providing a clear vision, and well-defined roles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Managers convey consistent objectives and a viable vision and strategy to employees with regards to the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Managers communicate a defined business process view through training and learning opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please feel free to make any comments or observations that you consider important and relevant regarding the above questions:

## Section G. Questions on Process Measurement & Management

To what extent do you agree with each of the following statements to explain the existence of a measurement & management system with regards to the key business processes within your organisation?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Process measurements (e.g. output quality, cycle time, process cost and variability) are defined for the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Specific process performance goals (e.g. target output quality, target cycle time, target process cost and target variability) are in place for the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Process performance (e.g. customer satisfaction, output quality, cycle time) is measured for the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The key business processes outcomes (e.g. real output quality, real cycle time, real process cost and real variability) are measured	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Resources (e.g. people, expenses, and other capital) are allocated based on the needs of these key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are feedback loops between functions for ongoing learning and improvements in the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please feel free to make any comments or observations that you consider important and relevant regarding the above questions:

## Section H. Questions on Process Structure

To what extent do you agree with each of the following statements with regards to your organisational structure?



	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The organisational structure can best be described and illustrated as a collection of processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The organisation structure supports seamless execution of key business processes across functions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The firm's organisational structure facilitates integration of flow of activities between functions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nearly all activities are executed by cross-functional teams, to which employees are being assigned	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The organisation has functional areas, but employees regularly participate in cross-functional teams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please feel free to make any comments or observations that you consider important and relevant regarding the above questions:

### Section I. Questions on Customer-Focused Process Values and Beliefs

To what extent do you agree with each of the following statements with regards to your organisation's approach towards its customers?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The customer is central to the organisation's business model	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Employees pay attention to the customer's needs in their jobs which are involved in the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Employees understand that the purpose of their functional area is to fulfil the needs of the internal/external customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Individuals on all levels of the organisation are speaking about business processes, customers, teams, process performance indicators, and so on	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Employees know their work affects subsequent works, customers, and the key business processes performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer satisfaction is used on a regular basis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer feedback is used intensively to improve product quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please feel free to make any comments or observations that you consider important and relevant regarding the above questions:

## Section J. Questions on Internal Integration

In this section I am interested in measuring the level of a cooperative environment within your organisation.

1. Please indicate to what extent you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Your organisation's functional areas/business units are jointly managed strategically	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your organisation's functional areas/business units participate in new product and process design with regards to the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your organisation's functional areas/business units attend in strategic meetings with regards to the key business processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Functional teams are aware of each other's responsibilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Functional teams have a common prioritisation of customers in case of supply shortages and how allocations will be made	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
All functional teams use common product roadmaps and other procedures to guide product launch	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Performance metrics promote rational trade-offs among customer service and operational costs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Planning decisions are based on plans agreed upon by all functional teams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Operational and tactical information is regularly exchanged between functional teams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. To what extent do you agree that your organisation's functions/business units pursue the following activities with each other?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Achieving goals collectively	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having a mutual understanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information sharing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Share the same vision for the organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work together as a team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conduct joint planning to anticipate and resolve operational problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People in different functions/business units are quite accessible to each other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People in different functions/business units coordinate their activities with each other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please feel free to make any comments or observations that you consider important and relevant regarding the above questions:

## Section K. Questions on Product Modularity

How would you describe your main products?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Products can be decomposed into separate modules	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We can make changes in the key component without redesigning others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Product components can be reused in various products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Products have high degree of component carry-over	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Products' components are standardized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Appendix 4.2. The Research Constructs Scales Operationalisation

Constructs	Multiple-Item Scales	Sources
Process Job (PJ)	<p>PJ1: Jobs are usually multidimensional and not just simple tasks in these processes</p> <p>PJ2: Jobs include frequent problem solving in these processes</p> <p>PJ3: Employees are constantly learning new things on the jobs which are involved in these processes</p> <p>PJ4: A process owner/manager, who takes the overall responsibility and authority of the process, has been assigned to each key process</p> <p>PJ5: Process owners/managers are experienced leaders/managers</p> <p>PJ6: The management of our organisation perceives process management not as a single project but as a way of managing the business</p> <p>PJ7: Management is committed to reviewing and improving the processes in line with the business needs</p> <p>PJ8: There is at least one senior executive who has taken leadership of and responsibility for the key business processes</p> <p>PJ9: The senior executive team is actively engaged in the key business processes program</p>	(McCormack, 1999, McAdam and McCormack, 2001, McCormack et al., 2003, Reijers, 2006, McCormack, 2007, Škrinjar et al., 2008, Chen et al., 2009a, Kohlbacher and Gruenwald, 2011a, Tang et al., 2013, Kohlbacher, 2013)
Process View (PV)	<p>PV1: Employees often view the business as a series of linked processes</p> <p>PV2: Process terms (input, output, process and process owners) are used in the conversation made between individuals across the organisation</p> <p>PV3: The key business processes are defined and documented by using the terms "inputs, outputs, to and from our customers"</p> <p>PV4: The key business processes are sufficiently defined and shared with employees by managers so that most employees know how they work</p> <p>PV5: There is a 'system view' in place (i.e. the entire process is managed)</p> <p>PV6: Management tries to eliminate resistance to change by providing a clear vision, and well-defined roles</p> <p>PV7: Managers convey consistent objectives and a viable vision and strategy to employees with regards to the key business processes</p> <p>PV8: Managers communicate a defined business process view through training and learning opportunities</p>	(McCormack, 1999, McAdam and McCormack, 2001, McCormack et al., 2003, McCormack, 2007, Reijers, 2006, Škrinjar et al., 2008, Chen et al., 2009a, Škrinjar et al., 2010, Kohlbacher and Gruenwald, 2011a, Škrinjar and Trkman, 2013, Tang et al., 2013, Movahedi et al., 2016)
Process Measurement & Management (PMM)	<p>PMM1: Process measurements (e.g. output quality, cycle time, process cost and variability) are defined for the key business processes</p> <p>PMM2: Specific process performance goals (e.g. target output quality, target cycle time, target process cost and target variability) are in place for the key business processes</p> <p>PMM3: Process performance (e.g. customer satisfaction, output quality, cycle time) is measured for the key business processes</p> <p>PMM4: The key business processes outcomes (e.g. real output quality, real cycle time, real process cost and real variability) are measured</p> <p>PMM5: Resources (e.g. people, expenses, and other capital) are allocated based on the needs of these key business processes</p> <p>PMM6: There are feedback loops between functions for ongoing learning and improvements in the key business processes</p>	(McCormack, 1999, McAdam and McCormack, 2001, McCormack et al., 2003, Reijers, 2006, McCormack, 2007, Škrinjar et al., 2008, Chen et al., 2009a, Škrinjar et al., 2010, Kohlbacher and Gruenwald, 2011a, Tang et al., 2013, Bronzo et al., 2013, Movahedi et al., 2016)
Process Structure (PS)	<p>PS1: The organisational structure can best be described and illustrated as a collection of processes</p> <p>PS2: The organisation structure supports seamless execution of key business processes across functions</p> <p>PS3: The firm's organisational structure facilitates integration of flow of activities between functions</p> <p>PS4: Nearly all activities are executed by cross-functional teams, to which employees are being assigned</p> <p>PS5: The organisation has functional areas, but employees regularly participate in cross-functional teams</p>	(Reijers, 2006, Škrinjar et al., 2010, Trkman, 2010, Kohlbacher and Gruenwald, 2011a, Škrinjar and Trkman, 2013, Bronzo et al., 2013, Santos et al., 2014)
Customer-Focused Process Values and Beliefs (CFPVB)	<p>CFPVB1: The customer is central to the organisation's business model</p> <p>CFPVB2: Employees pay attention to the customer's needs in their jobs which are involved in the key business processes</p> <p>CFPVB3: Employees understand that the purpose of their functional area is to fulfil the needs of the internal/external customers</p> <p>CFPVB4: Individuals on all levels of the organisation are speaking about business processes, customers, teams, process performance indicators, and so on</p> <p>CFPVB5: Employees know their work affects subsequent works, customers, and the key business processes performance</p> <p>CFPVB6: Customer satisfaction is used on a regular basis</p> <p>CFPVB7: Customer feedback is used intensively to improve product quality</p>	(McCormack, 1999, McAdam and McCormack, 2001, Chen et al., 2009a, Škrinjar et al., 2010, Bronzo et al., 2013, Kohlbacher, 2013, Santos et al., 2014, Movahedi et al., 2016)

<p style="text-align: center;"><b>Internal Integration (II)</b></p>	<p>II1: Your organisation's functional areas/business units are jointly managed strategically</p> <p>II2: Your organisation's functional areas/business units participate in new product and process design with regards to the key business processes</p> <p>II3: Your organisation's functional areas/business units attend in strategic meetings with regards to the key business processes</p> <p>II4: Functional teams are aware of each other's responsibilities</p> <p>II5: Functional teams have a common prioritisation of customers in case of supply shortages and how allocations will be made</p> <p>II6: All functional teams use common product roadmaps and other procedures to guide product launch</p> <p>II7: Performance metrics promote rational trade-offs among customer service and operational costs</p> <p>II8: Planning decisions are based on plans agreed upon by all functional teams (page 120)</p> <p>II9: Operational and tactical information is regularly exchanged between functional teams</p> <p>II10: Achieving goals collectively</p> <p>II11: Having a mutual understanding</p> <p>II12: Information sharing</p> <p>II13: Share the same vision for the organisation</p> <p>II14: Work together as a team</p> <p>II15: Conduct joint planning to anticipate and resolve operational problems</p> <p>II16: People in different functions/business units are quite accessible to each other</p> <p>II17: People in different functions/business units coordinate their activities with each other</p>	<p>(Jaworski and Kohli, 1993, Kahn, 1996, Ellinger, 2000, Narasimhan and ARAM, 2001, Narasimhan and Kim, 2002, Pagell, 2004, García Rodríguez et al., 2007, Tang et al., 2013, Huo et al., 2016)</p>
<p style="text-align: center;"><b>Product Modularity (PM)</b></p>	<p>PM1: Products can be decomposed into separate modules</p> <p>PM2: We can make changes in the key component without redesigning others</p> <p>PM3: Product components can be reused in various products</p> <p>PM4: Product have high degree of component carry-over</p> <p>PM5: Product's components are standardised</p>	<p>Antonio Lau K.W. et al. 2007</p>

### Appendix 4.3. A Sample of the Invitation Email

Dear (First Name)

I am a PhD student at Royal Holloway, University of London sponsored by the university to conduct a research on the factors affecting the successful achievement of internal supply chain integration in your industry.

Your participation will require approximately 10 minutes and is completed online at your computer. There are no known risks or discomforts associated with this survey. This study will be beneficial to high- and medium-tech manufacturing firms wishing to achieve an effective internal across their functional areas.

If you are interested in taking part, please **follow this link to the Survey:**

(SurveyLink?d=Take the Survey)

Or copy and paste the URL below into your internet browser:

(SurveyURL)

Follow the link to opt out of future emails:

(OptOutLink?d=Click here to unsubscribe)

A summary of my research's findings will be available on completion of my PhD upon your request. This will enable you to compare your company's performance with the results of the industry sample in key strategic areas. As a token of appreciation, the respondents will be entered into a prize draw of £50 Amazon voucher. So please provide your email address in the survey if you wish to be included.

If you feel that somebody else in your company may be in a better position to answer I would appreciate it if you could pass this information onto him/her.

This research is conducted in accordance with Royal Holloway Research Ethics Guidelines to ensure confidentiality and all the information provided will be treated in the strictest confidence. Taking part in this study is completely voluntary. If you choose to be in the study you can withdraw at any time without providing any reason. Your responses will be kept strictly confidential, and digital data will be stored in secure computer files. Any report of this research that is made available to the public will not include your name or any other individual information by which you could be identified. The information will be disseminated to the managers or any stakeholder in participating companies if they request for it, while ensuring their anonymity.

Your co-operation will be greatly appreciated, and I would be pleased to discuss the research with you in more detail if you would find it helpful.

Your sincerely,

**Vajihe Javadian MSc (Hons) MA (Hons)**

Doctoral Researcher

School of Management

Royal Holloway, University of London

Email: [Vajihe.javadian.2015@live.rhul.ac.uk](mailto:Vajihe.javadian.2015@live.rhul.ac.uk)

<<mailto:Vajihe.javadian.2015@live.rhul.ac.uk>>

Tell: +44 (0) 7557767739

**Research supervisor contact details:** Dr Adrian E Coronado Mondragon (Email: [Adrian.Coronado@rhul.ac.uk](mailto:Adrian.Coronado@rhul.ac.uk)), Dr José-Rodrigo Córdoba-Pachón (Email: [J.R.Cordoba-Pachon@rhul.ac](mailto:J.R.Cordoba-Pachon@rhul.ac)).

#### Appendix 4.4. A Review of Various Scales Operationalisation of Process Job (PJ) Construct

Author/s	Year	Process Job (PJ) Scales	
Kohlbacher M.	2013	Management commitment towards the process approach	<ol style="list-style-type: none"> <li>1. The management of our organization perceives process management not as a single project but as a way of managing the business</li> <li>2. There is at least one senior executive who has taken leadership of and responsibility for the process program</li> <li>3. The senior executive team is actively engaged in the process program</li> </ol>
Tang et al.	2013	<ol style="list-style-type: none"> <li>1. Jobs are usually multidimensional and not just simple tasks</li> <li>2. Jobs include frequent problem solving</li> <li>3. People are constantly learning new things on the job</li> </ol>	
Kohlbacher M. & Gruenwald S.	2011	Process owner	<ol style="list-style-type: none"> <li>1. Are process owners experienced leaders/managers?</li> <li>2. Process owners' influence over personnel assignments</li> <li>3. Process owners' responsibility for continuous improvement of their processes and proactive execution of this task</li> <li>4. Process owner's responsibility for budget</li> <li>5. Existence of process owners</li> <li>6. Process owners' power to be able to act for the process interest</li> </ol>
		Management commitment	<ol style="list-style-type: none"> <li>1. Active engagement of senior executive team in the process program</li> <li>2. Existence of a senior executive who has taken leadership and responsibility of the process program</li> <li>3. Existence of an instance coordinating and integrating process projects</li> <li>4. Management's perception of process management as a way of managing the business</li> </ol>
Trkman et al.	2010	<ol style="list-style-type: none"> <li>1. Are your supply chain processes documented and defined?</li> <li>2. Your chain organizational structure can be described as: (1—traditional function; 5—entirely process-based)</li> <li>3. Your supply chain performance measures can be described as: (1—traditional function; 5—entirely process-based)</li> <li>4. People in the supply chain organization can generally be described as: (1—internally-focused; 5—customer-focused)</li> <li>5. Jobs in the supply chain can generally be described as: (1— “limited”-task oriented; 5— “broad”-process-oriented) [All the scales are developed to measure BPO in an organization, within the context of SCM.]</li> </ol>	
Chen et al.	2009	<ol style="list-style-type: none"> <li>1. In our firm, business processes are sufficiently defined so that most employees have a clear understanding of these processes</li> <li>2. Our firm allocates resources based on business processes</li> <li>3. Our firm sets specific performance goals for different business processes</li> <li>4. Our firm measures the outcome of different business processes</li> <li>5. Our firm clearly designates process owners to assume responsibilities</li> <li>6. Employees are rewarded based on the performance of business processes in which they are involved [All the scales are developed to measure BPO in an organization.]</li> </ol>	
Škrinjar et al.	2008	<ol style="list-style-type: none"> <li>1. Jobs are usually multidimensional and not just simple tasks</li> <li>2. Jobs include frequent problem solving</li> <li>3. People are constantly learning new things on the job</li> </ol>	
Willaert et al.	2007	Not included in the study	
McCormack K.	2007	<ol style="list-style-type: none"> <li>1. Jobs are usually multidimensional and not just simple tasks</li> <li>2. Jobs include frequent problem solving</li> <li>3. People are constantly learning new things on the job</li> </ol>	
Reijers H.A.	2006	Ownership/Management	<ol style="list-style-type: none"> <li>1. There are no process owners (process managers) within the organization</li> <li>2. Owners have been appointed for the main processes</li> <li>3. There are process managers with full responsibility, for several processes</li> <li>4. There are process managers with full responsibility and authority for all main processes</li> <li>5. There is a clear and strong ownership of all processes at any level in the organization</li> </ol>

McCormack et al.	2003	1. Jobs are usually multidimensional and not just simple tasks 2. Jobs include frequent problem solving 3. People are constantly learning new things on the job
McCormack K.	2001	1. Jobs are usually multidimensional and not just simple tasks. 2. Jobs include frequent problem solving. 3. Employees are constantly learning new things on the job.
McCormack K. & Johnson W.C.	2001	1. Jobs are usually multidimensional and not just simple tasks 2. Jobs include frequent problem solving. 3. Employees are constantly learning new things on the job.
McCormack K.	1999	1. Jobs are usually multidimensional and not just simple tasks 2. Jobs include frequent problem solving. 3. People are constantly learning new things on the job.

#### Appendix 4.5. A Review of Various Scales Operationalisation of Process View (PV) Construct

Author/s	Year	Process View (PV) Scales	
Movahedi et al.	2016	<ol style="list-style-type: none"> <li>1. Conveying clear process mapping to employees</li> <li>2. Conveying consistent objectives and a viable vision and strategy to employees</li> <li>3. Communicating a defined process view through training and learning development</li> <li>4. Granting authority/delegation of responsibilities</li> <li>5. Top management and key stakeholders' support</li> <li>6. Management commitment</li> <li>7. Clear management direction on how work is performed "System view," i.e. entire process is managed</li> <li>8. Relation between processes and organizational goals</li> <li>9. Responsive and adaptive to change</li> <li>10. Availability of clear vision and well-defined roles which lead to elimination of resistance to change</li> </ol>	
Glavan et al.	2015	Not included in the study	
Tang et al.	2013	<ol style="list-style-type: none"> <li>1. The average employee views the business as a series of linked processes</li> <li>2. Process terms (input, output, process and process owners) are used in the conversation</li> <li>3. Processes are defined and documented by using inputs and outputs, to and from our customers</li> <li>4. The business processes are sufficiently defined so that most people know how they work</li> </ol>	
Škrinjar and Trkman, P.	2013	Employee training and empowerment	<ol style="list-style-type: none"> <li>1. Employees view the business as a series of linked processes</li> <li>2. Process terms such as input, output, process, and process owners are used in conversations</li> <li>3. Policy and strategy are communicated and cascaded throughout the organization</li> </ol>
Kohlbacher M. & Gruenwald S.	2011	<ol style="list-style-type: none"> <li>1. Design and documentation of processes</li> <li>2. Definition of processes' customers and suppliers</li> <li>3. Definition of processes' inputs and outputs</li> <li>4. Update of process documentation</li> <li>5. Existence of macro process model</li> <li>6. Existence of process variants if applicable</li> </ol>	
Škrinjar et al.	2010	<ol style="list-style-type: none"> <li>1. Core and supporting business processes are clearly defined in our organization</li> <li>2. Processes within our organization are documented with clearly defined inputs and outputs</li> <li>3. Process roles and responsibilities are clearly defined and documented</li> <li>4. Processes within our organization are defined so that most people in the organization know how they work</li> <li>5. Business process descriptions (models) are available to every employee in the company</li> <li>6. Our organization uses a standardized methodology for describing business processes</li> </ol>	
Trkman et al.	2010	<ol style="list-style-type: none"> <li>1. Are your supply chain processes documented and defined?</li> <li>2. Your chain organizational structure can be described as: (1—traditional function; 5—entirely process-based)</li> <li>3. Your supply chain performance measures can be described as: (1—traditional function; 5—entirely process-based)</li> </ol>	



		4. People in the supply chain organization can generally be described as: (1—internally-focused; 5—customer-focused) 5. Jobs in the supply chain can generally be described as: (1—“limited”-task oriented; 5—“broad”-process-oriented) [All the scales are developed to measure BPO in an organization, within the context of SCM.]	
Chen et al.	2009	1. In our firm, business processes are sufficiently defined so that most employees have a clear understanding of these processes 2. Our firm allocates resources based on business processes 3. Our firm sets specific performance goals for different business processes 4. Our firm measures the outcome of different business processes 5. Our firm clearly designates process owners to assume responsibilities 6. Employees are rewarded based on the performance of business processes in which they are involved	
Škrinjar et al.	2008	1. The average employee views the business as a series of linked processes 2. Process terms such as input, output, process, and process owners are used in conversation in the organization 3. Processes within the organization are defined and documented using inputs and outputs to and from our customers 4. The business processes are sufficiently defined so that most people in the organization know how they work 5. Implementation of information technology is based on the processes, not on functions	
Willaert et al.	2007	Not included in the study	
McCormack K.	2007	1. The average employee views the business as a series of linked processes 2. Process terms such as input, output, process, and process owners are used in conversation in the organization 3. Processes within the organization are defined and documented using inputs and outputs to and from our customers 4. The business processes are sufficiently defined so that most people in the organization know how they work 5. Implementation of information technology is based on the processes, not on functions	
Reijers H.A.	2006	Language	1. Employees talk about their own function and tasks 2. Employees talk about the functions and activities of their department 3. Terms like gaining input and delivering output are being used in conversations 4. Employees talk in terms of them being a part in a process, together creating a product 5. Employees on all levels of the organization talk in terms of processes, customers, teams, process performance, etc.
		Documentation	1. No processes have been identified 2. The main processes are identified and named 3. Several processes have been documented onto some level of detail 4. Processes are mostly documented, onto several levels of detail, using text documents and/or graphical illustrations. The documentation is occasionally updated 5. All processes are fully documented, using text documents, graphical models and/or dedicated software. Documentation is periodically updated
		Utilization	1. Processes are primarily being executed on an ad hoc basis 2. Processes execution carried out according to “business routine” 3. The actual way of working is based on the process descriptions, but frequently tasks are executed differently from the process descriptions 4. Processes are executed according to the process descriptions 5. Processes are executed according to the process descriptions. If occasionally a process cannot be executed according to its description, this is a reason for reviewing the process description
McCormack K. & Johnson W.C.	2003	1.The average employee views the business as a series of linked processes 2.Process terms such as input, output, process, and process owners are used in conversation in the organization 3.Processes within the organization are defined and documented using inputs and outputs to and from our customers 4.The business processes are sufficiently defined so that most people in the organization know how they work	
McCormack K.	2001	1. The average employee views the business as a series of linked processes. 2. Process terms such as input, output, process and process owners are used in conversation in the organization. 3. The business processes are sufficiently defined so that most employees know how they work.	
McCormack, K. & Johnson, B.	2001a	Not included in the study	
	2001b	1. The average employee views the business as a series of linked processes.	

McCormack K. & Johnson W.C.		2. Process terms such as input, output, process and process owners are used in conversation in the organization. 3. The business processes are sufficiently defined so that most employees know how they work.
McCormack K.	1999	1. The average employee views the business as a series of linked processes. 2. Process terms such as input, output, process, and process owners are used in conversation in the organization. 3. The business processes are sufficiently defined so that most people in the organization know how they work.

#### Appendix 4.6. A Review of Various Scales Operationalisation of Process Management & Measurement (PMM) Construct

Author/s	Year	Process Management & Measurement (PMM) Scales	
Movahendi et al.	2016	1. Feedback/analysis system in place (i.e. process outcomes are being measured) 2. Measurement of process performance 3. Measurement of defined processes 4. Measurement of resource allocation based on process requirements 5. Specific process performance goals in place 6. Measurement of business processes is a high priority for the organization's top management	
Bronzo et al.	2013	Measuring process performance	1. Development of indicators of process performance 2. Alignment of process goals to the organizational strategy 3. Performance goals for continuous improvement 4. Performance system oriented toward process maturity
Škrinjar, R. & Trkman, P.	2013	Performance measurement	1. Performance indicators are communicated within the organization on a regular basis 2. Performance results are used in setting improvement targets
Tang et al.	2013	1. Process performance (e.g., customer satisfaction) is measured 2. Process measurements (e.g., output quality, cycle time, process cost and variability) are defined 3. Resources (e.g., people, expenses, and other capital) are allocated based on process. 4. Specific process performance goals (e.g., target output quality, target cycle time, target process cost and target variability) are in place. 5. Process outcomes (e.g., real output quality, real cycle time, real process cost and real variability) are measured.	
Kohlbacher M. & Gruenwald S.	2011	1. Presentation of process performance metrics to workers 2. Continuous collection of process performance data 3. Action initiation by process performance indicators 4. Derivation of process performance indicators from enterprise goals 5. Existence of process performance indicators for processes 6. Use of process benchmarking 7. Use of activity-based costing 8. Existence of incentive systems emphasising the process' objectives	
Škrinjar et al.	2010	1. Process measures are defined and documented for each process 2. Process performance is measured in the organization 3. Performance targets are used for each process goal 4. Performance indicators are communicated within the organization on a regular basis 5. Performance results are used in setting improvement targets 6. Changes to processes must go through a formal change process 7. Process changes are communicated to all appropriate stakeholders	
Trkman et al.	2010	1. Are your supply chain processes documented and defined? 2. Your chain organizational structure can be described as: (1—traditional function; 5—entirely process-based) 3. Your supply chain performance measures can be described as: (1—traditional function; 5—entirely process-based) 4. People in the supply chain organization can generally be described as: (1—internally-focused; 5—customer-focused) 5. Jobs in the supply chain can generally be described as: (1—"limited"-task oriented; 5—"broad"-process-oriented) [All the scales are developed to measure BPO in an organization, within the context of SCM.]	

Chen et al.	2009	<ol style="list-style-type: none"> <li>1. In our firm, business processes are sufficiently defined so that most employees have a clear understanding of these processes</li> <li>2. Our firm allocates resources based on business processes</li> <li>3. Our firm sets specific performance goals for different business processes</li> <li>4. Our firm measures the outcome of different business processes</li> <li>5. Our firm clearly designates process owners to assume responsibilities</li> <li>6. Employees are rewarded based on the performance of business processes in which they are involved [All the scales are developed to measure BPO in an organization.]</li> </ol>	
Škrinjar et al.	2008	<ol style="list-style-type: none"> <li>1. Process performance is measured in the organization</li> <li>2. Process measurements are defined</li> <li>3. Resources are allocated based on process</li> <li>4. Specific process performance goals are in place</li> <li>5. Process outcomes are measured</li> <li>6. An on-line control of information quality in processes has been established</li> <li>7. Information flow through process is continuous and efficient</li> </ol>	
Willaert et al.	2007	Not included in the study	
McCormack K.	2007	<ol style="list-style-type: none"> <li>1. Process performance is measured in the organization</li> <li>2. Process measurements are defined</li> <li>3. Resources are allocated based on process</li> <li>4. Specific process performance goals are in place</li> <li>5. Process outcomes are measured</li> <li>6. It has been established an on-line control of information quality in processes</li> <li>7. Information flow through process is continuous and efficient</li> </ol>	
Reijers H.A.	2006	Performance measurement	<ol style="list-style-type: none"> <li>1. Performance measures are only related to employees</li> <li>2. Task related measures, like task-associated costs, processing time</li> <li>3. Product related measures, e.g. throughput time, product costs</li> <li>4. All main processes are measured using key performance indicators on a frequent basis</li> <li>5. Key performance indicators are used for continuous monitoring and optimizing performance of all main processes</li> </ol>
McCormack K. & Johnson W.C.	2003	<ol style="list-style-type: none"> <li>1. Process performance is measured in your organization</li> <li>2. Process measurements are defined</li> <li>3. Resources are allocated based on process</li> <li>4. Specific process performance goals are in place</li> <li>5. Process outcomes are measured</li> </ol>	
McCormack K.	2001	<ol style="list-style-type: none"> <li>1. Process performance is measured</li> <li>2. Process measurements are defined</li> <li>3. Resources are allocated based on process</li> <li>4. Specific process performance goals are in place</li> <li>5. Process outcomes are measured</li> </ol>	
McCormack K. & Johnson W.C.	2001	<ol style="list-style-type: none"> <li>1. Process performance is measured in your organization</li> <li>2. Process measurements are defined</li> <li>3. Resources are allocated based on process</li> <li>4. Specific process performance goals are in place</li> <li>5. Process outcomes are measured</li> </ol>	
McCormack K.	1999	<ol style="list-style-type: none"> <li>1. Process performance is measured in your organization.</li> <li>2. Process measurements are defined.</li> <li>3. Resources are allocated based on process.</li> <li>4. Specific process performance goals are in place.</li> <li>5. Process outcomes are measured.</li> </ol>	

#### Appendix 4.7. A Review of Various Scales Operationalisation of Process Structure (PS) Construct

Author/s	Year	Process Structure (PS) Scales	
Santos et al.	2014	Organizational structure	<ol style="list-style-type: none"> <li>1. The firm's organizational structure facilitates integration of the flow of activities between areas/departments</li> <li>2. The firm's organizational structure contains teams responsible for coordinating inter-departmental projects or processes</li> <li>3. The firm has people responsible for managing processes who are formally represented in the organizational chart</li> <li>4. The firm's organizational structure has an area or department responsible for proposing improvements in business processes</li> </ol>
Bronzo et al.	2013		<ol style="list-style-type: none"> <li>1. Integration level of the information flows among departments</li> <li>2. Integration level of the physical flows among departments</li> <li>3. Emphasis level for the coordination of inter-departmental activities</li> <li>4. Formal presence, on the company's organization chart, of the processes' manager ("owner")</li> </ol>
Škrinjar, R. & Trkman, P.	2013	Organizational changes	<ol style="list-style-type: none"> <li>1. The organizational structure supports processes across departments</li> <li>2. Process owners are appointed</li> </ol>
Kohlbacher M. & Gruenwald S.	2011		<ol style="list-style-type: none"> <li>1. Employees' attitude towards change</li> <li>2. Derivation of the organizational culture from process design</li> </ol>
Škrinjar et al.	2010		<ol style="list-style-type: none"> <li>1. Jobs are usually multidimensional and not just simple tasks</li> <li>2. The organizational structure supports seamless execution of processes across departments</li> <li>3. Employees often work in teams consisting of people from different departments</li> <li>4. Process ownership is defined and established</li> <li>5. Process owners are at the same hierarchical level as functional managers</li> <li>6. At what hierarchical level is the person responsible for business processes (e.g., the chief process officer)? (Member of top management; directly under top management; lower level of management; we do not have a person responsible for business processes)</li> <li>7. How is process management (responsibility for process documentation, administering process improvements, documenting changes, etc.) structured in your organization? (We have a dedicated organizational unit; process management is a part of wider organizational unit; selected individuals are responsible for process management; in no form)</li> </ol>
Trkman et al.	2010		<ol style="list-style-type: none"> <li>1. Are your supply chain processes documented and defined?</li> <li>2. Your chain organizational structure can be described as: (1—traditional function; 5—entirely process-based)</li> <li>3. Your supply chain performance measures can be described as: (1—traditional function; 5—entirely process-based)</li> <li>4. People in the supply chain organization can generally be described as: (1—internally-focused; 5—customer-focused)</li> <li>5. Jobs in the supply chain can generally be described as: (1—"limited"-task oriented; 5—"broad"-process-oriented) [All the scales are developed to measure BPO in an organization, within the context of SCM.]</li> </ol>
Chen et al.	2009		<ol style="list-style-type: none"> <li>1. In our firm, business processes are sufficiently defined so that most employees have a clear understanding of these processes</li> <li>2. Our firm allocates resources based on business processes</li> <li>3. Our firm sets specific performance goals for different business processes</li> <li>4. Our firm measures the outcome of different business processes</li> <li>5. Our firm clearly designates process owners to assume responsibilities</li> <li>6. Employees are rewarded based on the performance of business processes in which they are involved [All the scales are developed to measure BPO in an organization.]</li> </ol>
Reijers H.A.	2006	Organizational structure	<ol style="list-style-type: none"> <li>1. The organization is characterized by functional departments</li> <li>2. The organization has functional departments. Some cross-functional activities are executed by teams (e.g. new product development)</li> <li>3. The organization has functional departments, but employees regularly participate in cross-functional teams</li> <li>4. Nearly all activities are executed by cross-functional teams, to which employees are being assigned</li> <li>5. The organizational structure can best be illustrated as a collection of processes. Functionally based "centres of excellence" support them</li> </ol>
McCormack K.	1999		<ol style="list-style-type: none"> <li>1. Work units in this organization are process teams and functional departments.</li> <li>2. The organization is flat rather than hierarchical.</li> <li>3. Process owners in this organization are identified.</li> <li>4. The company is organized around 3-5 processes.</li> <li>5. The organization is built around processes.</li> <li>6. Teams manage everything in our organization.</li> <li>7. The organization is run almost entirely by functional groups.</li> <li>8. Processes in our organization have no identified owners.</li> </ol>

#### Appendix 4.8. A Review of Various Scales Operationalisation of Customer-Focused Process Values, and Beliefs construct (CFPVB) Construct

Author/s	Year	Customer-Focused Process Values, and Beliefs (CFPVB) Scales	
Movahendi et al.	2016	<ol style="list-style-type: none"> <li>1. Attention to customers' needs throughout all processes</li> <li>2. Existence of process culture in an organization with a strong emphasis on customer satisfaction</li> <li>3. Products are complex and adapted to customers' needs</li> </ol>	
Santos et al.	2014	Organizational culture	<ol style="list-style-type: none"> <li>1. Concepts such as process orientation and excellence in performing processes are discussed by management at periodic meetings</li> <li>2. In general, the employees understand the nature of the business as a series of interconnected processes</li> <li>3. The company is able to suitably manage conflicts between functions (or departments) and minimize resistance to changes in processes, when necessary</li> <li>4. Alignment exists in the company between the strategic objectives of its functional areas (marketing, sales, production and finance, among others)</li> <li>5. Managers hold meetings with the aim of improving the integration of the flows of activities associated with the various functional areas of the business (marketing, sales, production, finance, others).</li> </ol>
Bronzo et al.	2013	Culture and values of the organization	<ol style="list-style-type: none"> <li>1. Valuing the process culture in the organization</li> <li>2. Aligning process goals among the functional areas</li> <li>3. Inter-departmental conflict management</li> </ol>
		Customer orientation	<ol style="list-style-type: none"> <li>1. Centrality of the customer in the company's business model</li> <li>2. Measuring customer satisfaction</li> <li>3. Products and services produced to meet customer's expectations</li> <li>4. Intensive use of customer feedback to improve products quality</li> <li>5. Intensive use of customer feedback to improve process quality</li> </ol>
Kohlbacher M.	2013	Corporate culture in line with the process approach	<ol style="list-style-type: none"> <li>1. Teamwork (also between different departments) can be taken for granted in the organization</li> <li>2. Our organization's employees understand that the purpose of their work is to fulfil the needs of the internal/external customers</li> <li>3. Our organization's employees feel accountable for enterprise results</li> <li>4. Employees on all levels of the organization are speaking about business processes, customers, teams, process performance indicators, and so on</li> <li>5. employees can describe their business process' overall flow, they know how their work affects subsequent work, customers, and process performance'</li> </ol>
Kohlbacher M. & Gruenwald S.	2011	<ol style="list-style-type: none"> <li>1. Customer-focused attitude of employees</li> <li>2. Employees' accountability for firm results</li> <li>3. Existence of teamwork</li> <li>4. Worker's knowledge towards how processes are executed</li> <li>5. Use of process language</li> </ol>	
Trkman et al.	2010	<ol style="list-style-type: none"> <li>1. Are your supply chain processes documented and defined?</li> <li>2. Your chain organizational structure can be described as: (1—traditional function; 5—entirely process-based)</li> <li>3. Your supply chain performance measures can be described as: (1—traditional function; 5—entirely process-based)</li> <li>4. People in the supply chain organization can generally be described as: (1—internally-focused; 5—customer-focused)</li> <li>5. Jobs in the supply chain can generally be described as: (1—"limited"-task oriented; 5—"broad"-process-oriented) [All the scales are developed to measure BPO in an organization, within the context of SCM.]</li> </ol>	
Chen et al.	2009	<ol style="list-style-type: none"> <li>1. Our business objectives are driven primarily by customer satisfaction</li> <li>2. We communicate information about our customer experiences across all business functions</li> <li>3. Our strategy for gaining a competitive advantage is based. on our understanding of customer needs</li> <li>4. We measure customer satisfaction frequently</li> <li>5. We regularly survey end customers to assess the quality of our products and service</li> </ol>	
McCormack K. & Johnson W.C.	2001	Esprit de corps	<ol style="list-style-type: none"> <li>1. People in this business unit are genuinely concerned about the needs and problems of each other</li> <li>2. A team spirit pervades all ranks in this business unit</li> <li>3. Working for this business unit is like being part of a family</li> <li>4. People in this business unit feel emotionally attached to each other</li> <li>5. People in this business unit feel like they are "in it together"</li> <li>6. This business unit lacks an "esprit de corps"</li> </ol>

			7. People in this business unit view themselves as independent individuals who have to tolerate others around them
Reijers H.A.	2006	Customer requirements	<ol style="list-style-type: none"> <li>1. Customer requirements/satisfaction is only considered in terms of external complaints</li> <li>2. Measures of customer requirements/ satisfaction are available from surveys</li> <li>3. There is a customer care policy that is widely published</li> <li>4. Continuous research on identifying and meeting individual customer needs is embedded in the organization</li> <li>5. Customer satisfaction information is fed back into the organization in a structural manner (to Table AI. be used as management information)</li> </ol>
McCormack K.	1999	Customer-Focused Process Values, and Beliefs	<ol style="list-style-type: none"> <li>1. The management emphasises process improvement</li> <li>2. People are empowered rather than "controlled"</li> <li>3. Values are based upon being productive rather than protective</li> <li>4. The policy and procedures of the company make the organization feel empowered</li> <li>5. Authority to examine, challenge, and change work methods is delegated to cross-functional work teams</li> <li>6. Emphasis is placed on improving how work gets done</li> <li>7. Customers are asked about process performance</li> <li>8. All employees are well informed and trained</li> </ol>
		Esprit de corps	<ol style="list-style-type: none"> <li>1. People in this business unit are genuinely concerned about the needs and problems of each other</li> <li>2. A team spirit pervades all ranks in this business unit</li> <li>3. Working for this business unit is like being part of a family</li> <li>4. People in this business unit feel emotionally attached to each other</li> <li>5. People in this business unit feel like they are "in it together"</li> <li>6. This business unit lacks an "esprit de corps"</li> <li>7. People in this business unit view themselves as independent individuals who have to tolerate others around them</li> </ol>

### Appendix 5.1. Cross Tabulation Analysis of Organisations Size (Measured by the Number of Employees) and Their Turnover Size Band

Turnover Size Band * COMPANY SIZE Cross tabulation		COMPANY SIZE	
		0 through 249 employees	> 250 employees
Turnover Size Band	Turnover between 0-49k	1	0
	Turnover between 50k-99k	1	0
	Turnover between 100k-249k	3	0
	Turnover between 250k-499k	4	0
	Turnover between 500k-999k	9	0
	Turnover between 1000k-1999k	17	0
	Turnover between 2000k-4999k	53	1
	Turnover between 5000k-9999k	45	0
	Turnover between 10000k-49999k	40	11
	Turnover greater than 50000k+	2	21
Total		175	33

## Appendix 5.2. Demographics on the Position of Respondents

Position	Frequency	Percent
<b>Senior Level Management</b> (e.g. CEO, COO, General Manager, Managing Director, Non-Executive Director, Company Secretary, Senior Manager, Joint Managing Director, Business Development Director/Manager)	109	51
<b>Operational/Business level Managers</b> (e.g. Brand Manager, Chairman, Commercial Director, Project Director/Manager, Engineering Director/Manager, Finance and Operations Director, Finance Director/Manager, HR Director/Manager, HSQE (Health, Safety, Quality and Environmental) Manager, Industrial Manager, Innovation and Intellectual Property Manager, IT Manager, Manufacturing and Facilities Manager, Marketing Coordinator/Director/Manager, Materials Director, Operations Director/Manager, Pre-Production Manager, Production Director/Manager, Program Manager, Purchasing Manager, Quality Manager, Sales & Marketing Director/Manager, Service Director, Supply chain Manager, Technical Development Director/Manager, Technical Marketing Engineer & Legislation Officer)	103	48
<b>Other</b> (data scientist, consultant, and owner)	3	1

Job Title	Frequency	Percent
Brand Manager	1	0.5
Business Development Director/Manager	7	3.2
CEO	10	4.6
Chairman	6	2.8
Commercial Director	1	0.5
Company Secretary	2	0.9
Consultant	1	0.5
COO (Chief Operating Officer)	1	0.5
Data Scientist	1	0.5
Project Director/Manager	3	1.4
Director/Manager	23	10.6
Engineering Director/Manager	4	1.9
Finance and Operations Director	1	0.5
Finance Director/Manager	9	4.2
General Manager	8	3.7
HR Director/Manager	6	2.8
HSQE (Health, Safety, Quality and Environmental) Manager	4	1.9
Industrial Manager	1	0.5
Innovation and Intellectual Property Manager	1	0.5
IT Manager	2	0.9
Joint Managing Director	1	.5
Managing Director	53	24.5
Manufacturing and Facilities Manager	2	0.9
Marketing Coordinator/Director/Manager	6	2.8
Materials Director	1	0.5
Non-Executive Director	1	0.5
Operations Director/Manager	7	3.2
Owner	1	0.5
Pre-Production Manager	1	0.5
Production Director/Manager	4	1.9
Program Manager	1	0.5
Purchasing Manager	4	1.9
Quality Manager	9	4.2
Sales & Marketing Director/Manager	18	8.3
Senior Manager	3	1.4
Service Director	1	0.5
Supply chain Manager	1	0.5
Technical Development Director/Manager	8	3.7
Technical Marketing Engineer & Legislation Officer	1	0.5

### Appendix 5.3. II Variables Correlation Matrix

II Variables Correlation Matrix																		
		II1	II2	II3	II4	II5	II6	II7	II8	II9	II10	II11	II12	II13	II14	II15	II16	II17
II1	Pearson Correlation	1																
	Sig. (2-tailed)																	
	N	215																
II2	Pearson Correlation	.597**	1															
	Sig. (2-tailed)																	
	N	215	215															
II3	Pearson Correlation	.606**	.645**	1														
	Sig. (2-tailed)																	
	N	215	215	215														
II4	Pearson Correlation	.528**	.450**	.614**	1													
	Sig. (2-tailed)																	
	N	215	215	215	215													
II5	Pearson Correlation	.487**	.474**	.569**	.642**	1												
	Sig. (2-tailed)																	
	N	215	215	215	215	215												
II6	Pearson Correlation	.445**	.522**	.547**	.531**	.539**	1											
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215											
II7	Pearson Correlation	.499**	.490**	.535**	.389**	.499**	.681**	1										
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215										
II8	Pearson Correlation	.512**	.514**	.545**	.541**	.510**	.551**	.499**	1									
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215									
II9	Pearson Correlation	.530**	.563**	.638**	.604**	.583**	.468**	.437**	.604**	1								
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215								
II10	Pearson Correlation	.566**	.486**	.519**	.587**	.578**	.431**	.415**	.495**	.596**	1							
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215	215							
II11	Pearson Correlation	.514**	.441**	.507**	.607**	.551**	.382**	.375**	.498**	.595**	.856**	1						
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215	215	215						
II12	Pearson Correlation	.470**	.413**	.480**	.588**	.584**	.341**	.296**	.471**	.575**	.748**	.811**	1					
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215	215	215	215					
II13	Pearson Correlation	.532**	.446**	.478**	.568**	.491**	.343**	.325**	.446**	.557**	.699**	.725**	.723**	1				
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215	215	215	215	215				
II14	Pearson Correlation	.455**	.430**	.406**	.565**	.492**	.351**	.294**	.411**	.510**	.661**	.712**	.721**	.706**	1			
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215	215	215	215	215	215			
II15	Pearson Correlation	.530**	.456**	.529**	.553**	.551**	.485**	.396**	.515**	.601**	.666**	.683**	.637**	.676**	.662**	1		
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215		
II16	Pearson Correlation	.446**	.467**	.515**	.581**	.473**	.291**	.269**	.387**	.497**	.589**	.587**	.594**	.575**	.608**	.509**	1	
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	
II17	Pearson Correlation	.497**	.432**	.538**	.559**	.573**	.359**	.381**	.454**	.612**	.645**	.659**	.684**	.615**	.702**	.681**	.717**	1
	Sig. (2-tailed)																	
	N	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215
** Correlation is significant at the 0.01 level (2-tailed).																		

\*\* Correlation is significant at the 0.01 level (2-tailed).

### Appendix 5.4. Summary of the item-to-total Correlations and Alpha If Item deleted for the II Construct

Constructs	Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
II	II1	0.678	0.946	0.948
	II2	0.658	0.946	
	II3	0.73	0.945	
	II4	0.743	0.945	
	II5	0.72	0.945	
	II6	0.615	0.948	
	II7	0.574	0.949	
	II8	0.668	0.946	
	II9	0.751	0.944	
	II10	0.79	0.944	
	II11	0.784	0.944	
	II12	0.749	0.945	
	II13	0.73	0.945	
	II14	0.709	0.945	
	II15	0.759	0.944	
	II16	0.663	0.946	
	II17	0.748	0.944	